Canadian Public Health Journal

VOLUME XXIII

Published by the
CANADIAN PUBLIC HEALTH ASSOCIATION
1932

CANADIAN PUBLIC HEALTH JOURNAL

VOL. XXIII January, 1932 No. 1

The Menace of Raw Milk*

I. Milk-Borne Tuberculosis

R. I. HARRIS, M.C., M.B.

Associate Surgeon, Toronto General Hospital

IN 1901, when Robert Koch promulgated his famous announcement that bovine tubercle bacilli were innocuous to human beings, he lighted the fires of a scientific controversy which raged for more than a decade. His statement seemed at variance with past clinical experience. In 1846, long before the discovery of tubercle bacillus, Klencke noted the relationship between cow's milk and scrofula. The discovery of the tubercle bacillus by Koch in 1882 and the large amount of investigation carried out in the twenty years that preceded his controversial announcement, led to a clear conception of the infectious nature of the disease. Hence even the great weight of Koch's authority was not sufficient to permit his statement to pass unchallenged. As a singular example of truth arising out of error, we may state that our present knowledge of the significance of bovine tuberculosis is based upon his controversial statement. The immense amount of investigation it gave rise to has firmly established the pathogenicity of the tubercle bacillus for man and has demonstrated that for practical purposes, the sole mode of transmission is by means of infected milk.

Incidence of Bovine Tuberculosis in Man

How great is the incidence of bovine tuberculosis? Upon the answer to this question hangs its importance as a menace to public health. A survey of such figures as are available indicates that we have but incomplete knowledge of the incidence of bovine tuberculosis in man. There are several reasons for this lack of accurate information. To begin with, the task of determining that the tuberculous infection of any given patient is bovine in origin is tedious and time-consuming. The procedure necessary to determine whether a given strain of tubercle bacilli is of the human or bovine type involves first, the inoculation of the tuberculous material into a guinea-pig in order to obtain the organ-

*Presented at the Symposium on Milk-borne Diseases, 20th Annual Meeting, Canadian Public Health Association, Regina, June, 1931.

ism in large numbers and uncontaminated by more rapidly growing organisms. After the necessary six or eight weeks have elapsed, cultures from the infected organs of the guinea-pig are made on Dorset's egg medium. There the organisms must grow for a sufficient time and in sufficient abundance to provide 0.01 mgm. of the dried bacilli for intervenous inoculation into a rabbit. While the bovine organism has certain distinctive morphological and cultural characteristics, its pathogenicity for rabbits is its most distinctive feature. The intravenous injection of 0.01 mgm. of bovine tubercle bacilli into a rabbit produces a rapidly fatal and generalized tuberculosis which is not duplicated by a similar injection of human organisms. In addition to the great amount of tedious and painstaking work, the amount of time required for the determination of the source of a given strain of tubercle bacilli averages six months. Under these circumstances it is not surprising that statistics of the incidence of bovine tuberculosis are incomplete.

A further factor of importance is the wide variation in the frequency of occurrence of bovine tuberculosis in different countries, and indeed, in different parts of the same country. Obviously, the two important factors which will determine the incidence of bovine tuberculosis amongst the human beings of a community are: (1) the incidence of tuberculosis amongst the milch cattle of that community, and (2) the extent and efficiency to which pasteurization of the milk supply is carried out. As these two factors vary, so will the numbers of cases of bovine tuberculosis amongst human beings. To a very considerable extent these are factors under local control. Hence the incidence of bovine tuberculosis in man is almost entirely a local matter. Statistics compiled for one community probably have no application to another community, and certainly, the statistics of one country are of little value in the study of the disease in another country with different climate, and different standards of living, agriculture, and sanitation.

With this outline of their shortcomings we may examine such statistics as are available. They are excellently summarized in Savage's recent monograph.[1]

England.—Griffith's figures are quoted as representative of England. Amongst 1,294 cases of all types of tuberculosis, bovine infection appeared 306 times (24 per cent). The incidence was much higher in early life. Amongst 598 cases of bone and joint tuberculosis, the general incidence of bovine infection for all ages was 20 per cent; for children under five years, 33 per cent; and for children from five to ten years of age, 24 per cent. No case over twenty-three years of age yielded bovine organisms.

Scotland.—Wang's figures for 88 cases of all forms of tuberculosis, give the incidence of bovine infection as 55 per cent for cases under sixteen years of age, and 10 per cent for cases over sixteen years of age. Mitchell, from examination of 72 cases of tuberculous cervical adenitis

in children under twelve years of age, found the incidence of bovine infection to be 90 per cent. Fraser, in 70 cases of bone and joint tuberculosis in children under twelve years of age, found bovine infection in 61 per cent.

United States.—Park's figures for all forms of tuberculosis in New York city gives the incidence of bovine infection as 8 per cent. Gordon and Brown for the Boston district found bovine organisms accounting for 33 per cent of all forms of tuberculosis in children under twelve.

Canada.—While no figures relative to the incidence of bovine tuberculosis in man are available for Canada as a whole, some interesting light on the possibility of such infection occurring is revealed in Cameron's paper[2] on the incidence of tuberculosis in cattle. While his extensive survey of all the work done in the Dominion for the eradication of tuberculosis amongst cattle shows a gratifying low estimate of the incidence of the disease in this country (4 per cent in 6,000,000 cattle), it also indicates the necessity of constant re-check to eliminate fresh cases of tuberculosis. Thus under the accredited herd plan, 1919 to 1928, 13.5 per cent of 368,887 cattle were slaughtered as "reactors."

That the tuberculin test of cattle may not be without its limitation seems indicated in a paper by McKay and Hardman[3], on the septic sore throat epidemic in Kirkland Lake. Seven cows of a tuberculin-tested herd were slaughtered as possible sources of the streptococci which were causing the epidemic. All showed tuberculous lesions, and one was so heavily infected that the whole carcass was condemned.

Ontario.—It has been the singular good fortune of this community to have had the benefit of the services of an able and painstaking research worker in the problem of tuberculosis. For the figures concerning the incidence of tuberculosis in Ontario, I am indebted to my colleague, Dr. R. M. Price. Too much praise cannot be given her for the time and energy which she has expended on this work and the importance of the figures that she has compiled. Without doubt they will play an important part in the eradication of bovine tuberculosis from this province.

While the statistics of other countries are of value in establishing the fact that bovine infection does occur in man and often in a surprisingly high percentage of cases, it is with the incidence of the disease in our province that we are chiefly concerned. During the past five years, Dr. Price has examined the strains of tubercle bacilli from 340 patients. These for the most part were children suffering from all forms of tuberculosis, but with bone and joint lesions predominating. Amongst them proven bovine infection occurred in 13 per cent. Investigation of the bovine infections shows that in all of them the patient was accustomed to consume raw milk. No cases of bovine infection came from the city of Toronto, and for this immunity I think we may rightly give the credit to efficient pasteurization of milk.

Typical Case Reports

The association between infected milk and bovine infection has sometimes been striking. This can be illustrated forcibly by quotation of a few cases.

Interest in bovine infection commenced in 1926 with the appearance of a number of cases of tuberculous cervical adenitis from one district just beyond the confines of the city. In these cases the customary search for contact with an open case of pulmonary tuberculosis failed to reveal any evidence of human infection in their environment. Further search showed that all the cases came from a compact area, and that all received milk from the same unpasteurized source. In the course of time it was possible to prove that the organism with which they were infected was bovine in type, and to recover similar organisms from the milk. Though the district was outside the city and hence without the scope of the pasteurization by-law, it was possible to bring sufficient pressure to bear on the distributor to ensure the installation of a pasteurization plant.

M. D., a child six years of age, was seen first in May, 1929, suffering from tuberculous cervical adenitis. She was the daughter of a dairy farmer at Lansing. Her father, a shrewd and keen business man, had given some consideration to the question of having his herd accredited, but on business grounds had decided against it. His reasons for this decision were financial. He had seen his next-door neighbour, now the Premier of the Province, in the throes of establishing an accredited herd and had noted that it involved the sacrifice of most of his herd. The financial loss involved in such a transaction is great. The compensation from the government, plus the money derived from the sale of the cattle as beef, does not equal their value, and, further, they must be replaced by accredited cattle which cost appreciably more than grade cattle. For these reasons, and also since he had no reason to suppose that any of his cattle were tuberculous, he considered it better business to run a herd of grade cattle. The ultimate consumer of his product, he felt, was protected by pasteurization. He overlooked the possibility of infecting his own family. The organism from his daughter's tonsils and cervical glands was bovine in type. These facts led the father to have his herd tested. All his cattle save one had to be slaughtered, and two were so badly infected as to be unfit for food.

From Dr. Price's figures and these examples we may assume with reasonable certainty, that human infection with tubercle bacilli occurs in Ontario and that its incidence amongst children constitutes 13 per cent of all tuberculosis in this age group. While this is a comparatively small fraction of all cases of tuberculosis, it is of importance because no other form of tuberculosis is so easily eradicated.

The figures I have given you indicate the incidence of bovine tuberculosis in human beings. We have some figures which indicate the

frequency of tuberculous infection of milk. Of raw milk supplied the city of Toronto, 4 per cent yields tubercle bacilli on guinea-pig inoculation. In outlying districts, it is probable that the incidence of infected milk is much higher. There is some reason to believe that this amount of tuberculous infection in milk is not as dangerous as might be anticipated. Apparently, tuberculous milk in order to produce clinical tuberculosis, must be heavily infected. At any rate, not every patient consuming tuberculous milk develops clinical tuberculosis.

The Problem of Eradication

The importance of bovine tuberculosis in man lies not only in the amount of it which exists, but in the ease with which it can be completely eradicated. Pasteurization of the infected milk, if efficiently and consistently carried out, completely eliminates its ability to produce clinical tuberculosis. In communities where pasteurization of milk is carried out, bovine tuberculosis does not exist.

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II. Typhoid Fever

A. E. BERRY, C.E., PH.D.

Director of Sanitary Engineering Division, Ontario Department of Health

TYPHOID fever has, for many years, been successfully put forth as one of the best indicators of the menace of raw milk. The transmission of this disease through the use of raw milk was established by epidemiological studies even prior to the discovery of the typhoid bacillus. A comparatively short period has elapsed since the mortality from typhoid was listed among the major causes of death. The decline in this disease during the past twenty years has been continuous and well-nigh sensational. This reduction has been brought about by a number of factors, practically all of which have been preventive rather than curative. The application of proven methods of sanitation has been credited with the major part in this decline. Modern safeguards for public water supplies have no doubt contributed to the greatest extent. Milk pasteurization has also been an effective weapon. The typhoid mortality rates to-day, in most countries, are so low that

they might be interpreted to indicate that all serious danger from this disease had passed. Such hopes are quickly shattered by the periodic epidemics of milk-borne origin.

The epidemiology of typhoid fever outbreaks is featured by at least three significant factors:—

1. The infection is seldom detected until some time after it has begun to spread. Widespread dissemination can take place before the end of the incubation period, when it is recognized.
2. The general use of milk, especially in the diet of children, makes exposure to infection quite extensive.
3. Control of the disease is made difficult by the presence of carriers.

The number of typhoid carriers has been estimated at from 5 to 10 per cent of the recovered cases. In the Kingsville and Chatham studies in Ontario this was 5.3 per cent. The gravity of this can well be visualized when it is recalled that milk is so readily infected, and that it may offer every opportunity for multiplication of these organisms.

The menace from unprotected milk supplies may be reasonably judged by the number of cases of milk-borne diseases reported from time to time. The difficulty of securing accurate reports on the origin of all cases is exceedingly great. The reported cases of typhoid fever and other diseases which may be disseminated by milk may be placed into two groups; viz., those which, as the result of an adequate investigation, can be definitely attributed to milk, and, second, those which are not so obviously associated with milk but which can be regarded with suspicion. The former are chiefly associated with epidemics. The cases of ill-defined origin but which are really from milk undoubtedly constitute a very large number, but due to their sporadic occurrence, and the limited number of cases at any one time, it is difficult to accurately determine the cause of the infection.

The real menace of raw milk, therefore, must be considered largely from the data available from those epidemics which have been recorded. Here again difficulty is met, in that the investigations of the past were probably not so intensively conducted as in recent years. Especially may this be true of the smaller outbreaks.

Milk-borne epidemics have been summarized over various periods. An early summary was made by Trask, and covered a 27-year period from 1880 to 1907. In this period he reports 500 epidemics in all countries. One hundred and sixty-eight of these were in the United States. This is an average in the United States of six outbreaks per year. A further summary was made by the United States Public Health Service for the six-year period, 1918-1923 inclusive. In the United States in that period there were 112 outbreaks reported, or 18.7 a year. In the years 1924 to 1929 inclusive, this number was increased to an average of 43 epidemics a year. In the following year, 1930, 39 epidemics were reported. If these figures could be accepted as complete; they would

offer some interesting speculations. In the earliest period reported, namely, 1880 to 1907, only six epidemics were reported per year. This number has steadily increased to 18.7 a year in the 1918 to 1923 period; to 43 epidemics in the 1924 to 1929 period; and to 39 in 1930. Of the 44 epidemics reported in 1929, all but one were caused by raw milk. There is every reason to believe that a number of abnormal factors may have been responsible for the small number of outbreaks reported in the earlier years. This is not likely to have been the case in more recent times. The fact that the number of reported milk-borne epidemics has increased, or at least has not decreased, over this period in the United States is not an encouraging situation. Water-borne outbreaks would present quite a different picture. It must indicate, at least, a persistent menace from raw milk supplies.

The relationship between the milk-borne typhoid fever epidemics and the total number of milk epidemics throws some interesting light on this situation. In the milk outbreaks reported for these various periods the typhoid epidemics stand out most prominently. In the periods listed typhoid outbreaks vary from 57 per cent to 80 per cent of the total, as follows:—

Period	*Percentage typhoid fever epidemics form of all milk-borne epidemics*
1880-1907	63
1918-1923	78
1924	80
1924-1929	69
1929	60
1930	57

These figures clearly portray that in the number of milk epidemics the greatest menace has always been and still is from typhoid fever. While the greatest number of milk-borne epidemics have been of typhoid fever, the greatest number of cases have been recorded in outbreaks of septic sore throat.

Thus Bigelow and Forsbeck have shown in a study of typhoid fever, scarlet fever, septic sore throat and diphtheria in Massachusetts over a period of thirty-four years that, if these diseases be arranged in the order of epidemic frequency, typhoid fever would be first, scarlet fever second, septic sore throat third and diphtheria fourth. If, however, the order be determined by the number of cases occurring in the epidemics, septic sore throat would be first and typhoid fever second. In Massachusetts the proportion of typhoid fever which has been traced to milk has increased markedly.

In Ontario a similar situation may be said to exist. The typhoid mortality has been dropping steadily from approximately 30 deaths per

100,000 population to the present low figure of about two per 100,000. The proportion of the present typhoid fever which results from milk supplies is undoubtedly high. Epidemics have occurred periodically. During the last seven years 82 per cent of these epidemics have been of typhoid fever. In spite of this, one outbreak of septic sore throat showed more cases than all the typhoid epidemics together.

The menace of milk-borne typhoid fever in Canada may well be illustrated by the epidemics which have been reported in recent years. The most severe of all was the one which occurred in Montreal in 1928, with approximately 5,000 cases. In Chatham, Ontario, a severe outbreak contributed some 115 cases. This epidemic was associated with one milk route. In Belleville, Ontario, another typhoid epidemic recently made its appearance. This was traced to one raw milk route. In addition to these there have been smaller outbreaks from time to time. The presence of these epidemics during recent years only goes to show that they may be expected to continue until such time as the necessary protective measures are in force.

Present typhoid situation

These statistics from different countries indicate that the greatest chance for infection in a milk supply is still typhoid fever. That the number of cases of this disease is less than that of some others may possibly be attributed to changing conditions and to the manner in which the infection enters the supply. The increasing use of pasteurization in the larger centres of population has resulted in the transfer of milk-borne typhoid from urban to rural parts. Under these conditions the possibility of large outbreaks is fairly well limited. In 1930, in the United States, 54 per cent of the milk epidemics occurred in communities with a population of less than 2,500, and 67 per cent of the outbreaks were reported in centres with a population below 5,000. This condition is further emphasized by the very low typhoid mortality in the urban centres. Typhoid fever in Ontario is now a disease associated with rural communities. The larger the rural population in any country, the greater is the likelihood of higher typhoid mortality.

The excellent results in typhoid reduction in the cities, attributed chiefly to water treatment and milk pasteurization, afford an unchallenged direction for the control of this disease. While general pasteurization of all milk may be difficult, no effort should be spared to promote this safeguard. The expenditure for equipment is not unreasonable for even the small dairy. The pasteurization of milk in urban centres is steadily increasing. Precautions must be observed, however, to ensure that a false sense of safety is not created. Pasteurizing equipment and the methods employed may be faulty. The public must be safeguarded in assuming that all milk labelled "pasteurized" is safe. This will be possible only when adequate supervision is maintained by responsible and qualified authorities.

III. Septic Sore Throat

A. L. McKAY, B.A., M.B., D.P.H.

Director, Division of Preventable Diseases, Department of Health, Ontario

THAT there is an infection of the throat commonly associated with general systemic symptoms and giving rise to a particular clinical entity septic sore throat is now more or less generally accepted. Streptococcal infections of the throat such as scarlet fever and acute follicular tonsillitis are commonly seen and to the experienced observer may be easily differentiated from this infection. That there is evidence of isolated cases of septic sore throat and carriers of the organism has also been stated. Three such sporadic cases were reported by Pilot and Davis, and the same observers also reported the finding of three individuals, in a series of 400 throat examinations, who were carrying the organism without any subjective symptoms.

It is generally accepted that the disease is chiefly spread by the ingestion of infected milk, but an epidemic in an army hospital was reported by Keegan in which wound infection and septic sore throat coexisted. The milk supply in this case could be ruled out as the source of infection and the epidemic was controlled by segregation of those who were found to be carriers of haemolytic streptococci. There is some evidence lacking, however, in this presentation as there is no bacteriological evidence to show that this particular haemolytic streptococcus was identical with that usually ascribed as the cause.

At this point it might be well to consider the bacteriology of this disease. The aetiology has been ascribed to a haemolytic streptococcus of the *Beta* type (Brown). One group of observers have used ascitic blood agar and claim that it gives a colony with characteristics that differentiate it from other haemolytic streptococci. The reactions in various sugar media, its virulence for various laboratory animals, non hydrolysis of sodium hippurate and acid production are all cited as being points in differentiation. An organism complying with these various criteria has been named by some observers "Streptococcus epidemicus." In investigations of certain epidemics this organism has been isolated from the milk of infected cows, from certain milk handlers, from the throats of patients and, in at least one instance, from the blood stream of a patient. Other observers claim, however, that it is impossible to differentiate this organism from other haemolytic streptococci, notably scarlet fever, erysipelas and certain cases of puerperal sepsis. From the practical standpoint, however, the important fact is that a certain streptococcus is known to produce septic sore throat in man and that this organism is usually spread by the use of infected milk.

How does this organism get into the milk and when? It has been found in the investigation of various epidemics that usually one or more cows

have an infection of the udder and are excreting this organism in large numbers in the milk. Frost *et al* report, however, that in a routine investigation of milk from certified dairies 17 cows were found to be excreting the so-called Streptococcus epidemicus, but an outbreak of septic sore throat could be traced to only two of these cows, although the milk of the other fifteen cows had also been used for human consumption. Further, this epidemiological evidence is disturbing to the bacteriolgical conception of the disease. Differentiation of strains requires further bacteriological research.

The infection in the udder of the cow is not always apparent on superficial examination. This hidden danger is important, especially in the case of communities which rely solely on veterinary inspection of the animals and routine milk analysis for the protection of their milk supply. There may be some indication of this infection in one-quarter of the udder, but such a condition apparently is by no means constant. These organisms have been shown to be excreted during one to thirteen months. In some instances the excretion has been intermittent. The ordinary streptococcal infection of the udder (garget), which may be differentiated both bacteriologically and clinically, does not seem to be pathogenic for man. Certainly if it were so, such an infection would be very prevalent owing to the enormous amount of milk used in the raw state and the reported prevalence of this disease in cattle. That there may be several strains of haemolytic streptococci in raw milk is well known. Most of these strains, however, would appear to be non-pathogenic but that there is a certain strain capable of producing septic sore throat in man must also be admitted.

Whence is this strain obtained and how does it gain entrance into the cow's udder? In 1911, Savage postulated a theory that the streptococci found in the udder of cows held responsible for epidemics of septic sore throat were of human origin, most commonly from a milker. This theory of the cow acting as a passive carrier of human haemolytic streptococci, which cause septic sore throat in man, has been confirmed many times in the investigations of epidemics of septic sore throat in Europe and America. At a recent meeting of the Royal Society of Medicine in the Section of Comparative Medicine and Epidemiology, these views of Dr. Savage were finally accepted. It has been shown both experimentally and by experience that not all human strains, even if implanted in the udder, will cause septic sore throat, but it is also considered from epidemiological and bacteriological evidence that certain strains of haemolytic streptococci of human origin when implanted in the udder, may result in the causation of septic sore throat in man when the milk is used in the raw state.

How prevalent is septic sore throat and how often do epidemics of this disease occur? Scamman reports 45 outbreaks of this disease in the United States in the period of 1893-1928, accounting for 22,431 cases and 187 deaths. Crumbine reported (at the meeting of the State and

Provincial Health Authorities) for the period of six years, 1924-9 inclusive, 22 milk-borne epidemics in the United States of septic sore throat, with 4,161 cases and 76 deaths. In this compilation, septic sore throat leads the list of milk-borne diseases in the number of cases but not in the number of epidemics, typhoid fever being first, and septic sore throat second only to milk-borne typhoid fever in numbers of deaths. No definite epidemics of milk-borne septic sore throat were reported in Canada during the period 1924-1929. As septic sore throat is not included in the list of notifiable diseases compiled by the Dominion Bureau of Statistics, it is impossible to give the endemic occurrence of this disease in the various provinces. However, in the six-year period, 1924-1929, in Ontario, the number of cases reported was as follows:—

	Cases	*Deaths*
1924	55	4
1925	55	2
1926	18	1
1927	32	1
1928	109	4
1929	73	2

There was nothing in the way of an epidemic reported in these years, the cases being widely scattered and in small groups spread over a considerable period of time. In some instances these may not have been true cases of septic sore throat.

In the latter part of 1930, however, there occurred a severe epidemic of this disease at Kirkland Lake, Ont. During the four-week period between Nov. 29th and Dec. 26th, there occurred 383 cases and four deaths and the five weeks prior to and three weeks subsequent to this period accounted for an additional 74 cases, making a total of 457 cases and four deaths in this epidemic. As soon as word was received of this outbreak an epidemiological and bacteriological investigation was begun. The doctors attending the cases were at once struck with the fact that most of the patients had been using milk from one dairy. The chief milk supply of the town, which has a population approximately of 8,000, was obtained from four raw-milk dairies. The dairy under suspicion as the source of this epidemic was found to supply 36 per cent households but had on its route 84 per cent of the families suffering from septic sore throat. Two other dairies, supplying, respectively, 38 per cent and 20 per cent of all households, each had seven per cent of all families with septic sore throat. The fact that each of these dairies had cases among their customers may be accounted for by the fact that during the early part of the epidemic they had purchased milk from the infected dairy in order to augment their own supply. This milk was not mixed with the general supply but was sold separately.

A physical examination was made of all the cattle in these four dairies and samples of milk taken from each cow. When there was

evidence of acute or chronic mastitis, a sample was taken. The bacteriological evidence showed that two cows in the infected dairy were principally involved in the causation of the outbreak. The milk from one cow gave a haemolytic streptococcus which was indistinguishable from that obtained from the throats of the patients and from the throats of certain members of the family of the producer and from one milker who regularly milked the animal. At the home of this dairyman, which adjoined the dairy, two members of the household had suffered attacks of scarlet fever prior to the epidemic. Another member had a running ear and still another had a sore throat but continued to work in the dairy. Haemolytic streptococci were obtained from throat swabs of all these individuals at the height of the epidemic.

The evidence was conclusive that the milk supply of this dairy was the source of the epidemic and that at least one of the cows was excreting the organism in the milk. The sale of all raw milk was prohibited and a compulsory pasteurization by-law was passed immediately. Although 59 cases occurred subsequent to the stopping of the sale of raw milk, these were contact cases in households where the disease existed. Seven cattle from the infected dairy were slaughtered. It was interesting to note in the veterinarians' report on these animals that although they were supposed to be from a tuberculin-tested and tuberculosis-free herd, one of these animals was so heavily infected with tuberculosis that the whole carcass was condemend.

Pasteurization is our safeguard. Ayer and Thomson showed that 33 per cent of 239 strains of streptococci were able to survive 145° F. for 30 minutes, but he also found that all strains pathogenic to man were killed at temperatures between 115-135° F. for 30 minutes, well below the level of the temperature used in commercial pasteurization.

Our protection from this disease is efficient, well-controlled, thorough pasteurization.

IV. Undulant Fever

A. L. McNABB, D.V.Sc.

Director, Provincial Laboratories, Department of Health, Ontario

UNDULANT fever is an infection transmitted to man through the ingestion of raw milk or by contact with infected animals. Although only recently recognized, it presents a problem in the field of public health. The first published reports of cases in Canada appeared in the CANADIAN PUBLIC HEALTH JOURNAL in June, 1928.[1 2] The causative agent is the organism responsible for contagious abortion in cattle.

Frequency of Contagious Abortion Infection in Cattle

Contagious abortion occurs in the herds of Ontario to such an extent that it presents a serious economic problem. Mitchell,[3] of the Animal Diseases Research Institute, Department of Agriculture, Ottawa, has estimated that twenty per cent of our dairy cattle are infected and that one per cent are eliminating the causative organism in the milk. Mohler, of the Bureau of Animal Industry, Washington, estimated the annual economic loss resulting from this infection in the United States to be $50,000,000.

In a survey made last year by the Ontario Research Foundation, the cattle in 22 herds, comprising 1,140 animals, were tested. On the first test, 345 or 30.5 per cent of these animals gave a positive reaction; 75, or 6.6 per cent, were suspicious. One hundred abortions occurred. Of reacting animals, 87, or 13.7 per cent, aborted; of the non-reacting animals, 1.2 per cent aborted. If a loss of $50 per cow is used as a basis for calculation, it is readily seen that the annual economic loss in Canada is astounding. This loss must be considered entirely apart and secondary to the primary danger, the health of human beings. There is also the danger of contagion to other cattle.

The Causative Agent

The nomenclature of the causative agent has changed since Bang's discovery in 1897, when he isolated the organism from an aborted bovine foetus. In 1914, Traum isolated an organism, then indistinguishable from Bang's organism, from a porcine foetus. In 1918, Alice Evans showed the close relationship between Br. abortus (Bang) and Br. melitensis, the organism discovered by Bruce in 1887 to be the cause of Malta fever in man and shown later to be harboured in the milk of infected goats. Numerous names have been suggested. Probably the most commonly used term now is Brucella melitensis (Bruce), for the goat strain, Brucella abortus (Bang) for the bovine strain, and Brucella suis (Traum) for the porcine strain. The fact that a given strain comes from a cow, a hog or a goat is not conclusive proof that it is Br. abortus, suis, or melitensis. It is possible to isolate a porcine strain from a bovine source and *vice versa*.

Br. abortus is relatively resistant to desiccation and will remain alive for several months in a retained mummified foetus and for a year on culture medium. Experimentally, Carpenter[4] has found the organism to be fairly resistant in milk and butter. In cream artifically infected with two bovine strains, he found the organism viable for eight days when stored at 8°C. Two strains, inoculated into butter, remained pathogenic for guinea-pigs for 81 days and 32 days. No infection was found in guinea-pigs injected after 142 days and 41 days, respectively. Two other strains, one bovine and one human, remained pathogenic for the guinea-pig up to a period of ten days. The thermal death point of

four strains was studied. Two strains, one bovine and one human strain, resisted for 10 minutes a temperature of 140°F., while other strains failed to show any growth on culture after being subjected to the same temperature for the same length of time. One bovine strain and one human strain failed to survive exposure for 15 minutes to a temperature of 140°F. A porcine (hog) strain was more resistant, withstanding 140°F. for 15 minutes, 142°F. for 10 minutes, and 145°F. for five minutes, but failed to grow on culture after being exposed for 20 minutes to 140°F., 15 minutes at 142°F. and 10 minutes at 145°F. Carpenter believes, therefore, that proper pasteurization as recommended for the destruction of the tubercle bacillus, that is, 140°F.-145°F. for 30 minutes, is effective also for Br. abortus.

Incidence of Brucella Abortus in Milk

Cattle showing specific agglutinins in their serum, when diluted 1-100 or higher, are considered infected and from 30 to 50 per cent of these eliminate the organism in their milk. Schroeder and Cotton examined the milk from thirty cows whose blood showed an agglutination of at least 1:1000. At the Central Laboratory, Ontario Department of Health, samples of milk from thirty reacting cows showed Br. abortus in nine, or 30 per cent. Examination of a series at the Ontario Research Foundation showed Br. abortus present in 43 per cent of the samples taken from reacting cows.

To isolate the organism from raw milk, the inoculation of guinea-pigs with the sediment and cream from centrifuged samples of milk or cream is the most satisfactory method. Animals injected with cream show a higher percentage of positives, as the fat droplets, in rising to the top of the tube, tend to carry the organisms with them. In examination of the blood sera from cattle, it is advisable to carry out repeat tests at monthly intervals. The agglutination test on the blood serum from reacting animals should be supplemented by agglutination of the milk whey.

Laboratory Identification

Various methods have been adopted for the isolation of the organism. Strains of Br. abortus and of Br. melitensis have been isolated from human blood simply by culturing the clot for from 10 to 21 days at 37°C. in dextrose broth. Transfers made at the end of ten days showed the fine typical growth but earlier transfers failed to grow. After the second subculturing the organism grew readily. One method employed in the isolation of the organism has been to reduce the oxygen tension of the cultures by adding carbon dioxide. At the Central Laboratory, Ontario Department of Health, this organism has been isolated from human blood on three occasions. On typing these strains by their reaction to dyes, the method proposed by Huddleston, they all proved to be of bovine origin.

The agglutination test is the most practical laboratory diagnostic technique. In one case identified by our laboratory the agglutination test was negative, while the complement fixation test was positive, but in all other instances where both tests have been carried out, the results were in accord. The agglutination titre has varied from 1-80 to 1-5000. The vast majority of cases diagnosed have shown a titre of 1-640.

Incidence of Infection in Ontario

At the Ontario Department of Health Laboratories, 1,000 Wassermann sera have been examined for agglutinins for Br. abortus. Of this number, only four gave a positive reaction in the 1-20 dilution.

From July 1st to December 31st, 1928, 856 whole blood specimens submitted for examination for typhoid infection were also examined for evidence of Br. abortus infection. Of this number, 17, or 1.9 per cent, gave positive reactions for Br. abortus. In the year 1929, 35 cases of undulant fever were thus diagnosed. In 1930, 1,125 whole bloods were examined. Of this number, 193 gave positive reactions for typhoid, 30 for paratyphoid B., and 54, or 4.8 per cent of all whole bloods examined at the Central Laboratory, gave positive reactions for Br. abortus. Thirteen additional positive sera were reported from the Ontario Branch Laboratories. Since Jan. 1st, 1931, of the whole bloods submitted to our laboratory, 9.21 per cent have been positive for typhoid, 11.14 per cent positive for para B. and 3.5 per cent for Br. abortus.

According to Hasseltine[5], in the United States in 1925, 128 cases of undulant fever were reported and this number has practically doubled each year. In 1929, undulant fever infection was present in every state of the Union. He estimates the incidence rate of the disease for the United States for the year 1930 as 2 per 100,000 population, or about one-tenth that of typhoid fever. For the year 1930, Ontario's population was 3,314,000. Sixty-seven cases of undulant fever identified gave a morbidity rate of approximately two per 100,000. The majority of cases occurred in the age group of 25-40 years of age.

The Distribution by Occupation and Source of Infection

Of the 136 cases diagnosed, the occupation was as follows:—

NON CONTACTS		
Nurses	2	
Clergymen	1	
Physicians	3	
Urban Residents	6	
Dietitians	1	
CONTACTS		
Veterinary Surgeons	3	(one a laboratory infection)
Meat Packers	1	
Dairy and Farm Workers and Rural Residents	119	

In Denmark, Axel Thomsen tested the blood of 272 persons having contact with animals, and 62 having no contact. In the "no contact" group, no positive reactions were obtained. In the "contact" group, 110 positive reactions were obtained.

In Denmark, Madsen attributes 40 per cent of the cases to the consumption of raw milk and 60 per cent to contact with infected animals. The United States figures suggest 45 per cent of cases due to raw milk consumption and 55 per cent to contact. In Ontario the source of infection is rather difficult to determine, as the vast majority of our cases used raw milk and were contacts.

Symptomatology

As reported to us, the disease has varied widely in its severity. The length of illness was from three weeks to three months. The outstanding symptom was fever, usually in the afternoon and evening, and giving a temperature curve of the typical undulant variety. In many instances the elevation of temperature has been accompanied by chills followed by a drenching sweat. There have usually been persistent headache, lassitude, some anorexia and either constipation or diarrhoea. Loss of weight was noted in some instances. In a few cases in which blood counts had been made there was usually a leucopenia and the total red blood counts were somewhat reduced. In three cases there was a leucocytosis. It is reported that the organism may be recovered in some instances from the urine of the patient. No cultures from urine samples were made in these cases.

This is one disease in which laboratory aid is almost essential for diagnosis. The differential diagnosis in these cases has been between typhoid fever, influenza, tuberculosis and malaria. A typical typhoid fever and influenza are the diseases most likely to be confused with this infection.

Prevention

Experimental evidence thus far gives little hope for results from immunization. Gwatkin,[6] of the Ontario Research Foundation, found that the injection of heat-killed organisms in guinea-pigs does not protect these animals from infection.

Farm and dairy workers, meat packers and butchers, should be educated as to the advisability of wearing gloves when handling animals. Cuts or abrasions should receive prompt attention. The low incidence of active undulant fever infection amongst veterinarians having close contact with infected animals may be due to the aseptic precautions taken by them.

The necessity for and the value of general pasteurization of milk is evident. In that lies our most effective means of prevention.

Conclusions

(1) Effective pasteurization is one of the effective methods of protecting man from milk-borne infection of undulant fever. Widespread application of pasteurization would eliminate much of this disease. Where commercial pasteurization is not practical, home pasteurization should be carried out.

(2) Laboratory assistance is essential for the diagnosis of this disease, both in man and animals.

(3) Contagious abortion of cattle presents a difficult problem in which the medical and veterinary professions should unite in research studies and control.

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Discussion

Space permits only of the publication of the remarks of Dr. N. B. Sutton, M.B., D.P.H., District Officer of Health, Peterboro, Ontario, who opened the discussion; of Dr. John A. Amyot, C.M.G., Deputy Minister of Pensions and National Health, Ottawa; and of Dr. J. W. McIntosh, B.A., M.B., D.P.H., Medical Health Officer, Vancouver, B.C., who closed it.

Dr. N. B. Sutton, M.B., D.P.H., District Officer of Health, Peterboro.—Some three or four years ago, at the Ontario Health Officers' Convention, the M.O.H. of Scarboro described an outbreak of diphtheria in a closely settled suburban area. This was traced to a new hand employed at a raw milk dairy, who was found to be a carrier.

The recent outbreak of septic sore throat in Kirkland Lake, which was traced to a raw milk supply whose haemolytic streptococci were derived from the udder of at least one cow and from the throats of milkers, is still too fresh in everyone's mind to merit enlarging upon. It remains only to point out that the care and methods of this dairy would appear to have been considerably above those of the average dairy in Ontario; and to emphasize that pasteurization stopped the epidemic by drying up its raw milk source.

Undulant fever has too recently emerged into the consciousness of the medical profession, or even into that of health workers, to have collected many interesting case histories. Just this spring, however, I have heard of a very strenuous opponent of pasteurization who was most effectively silenced by spending a few weeks in bed with this disease. I expect the literature will be enriched by several instances of such poetic justice, before complete pasteurization of milk supplies will have stopped their accumulation.

A recent issue of the *Journal* contained an account of an outbreak of typhoid fever which I would here summarize, in case you may have missed it. This outbreak of sporadic cases was ultimately traced to a man of seventy

who had suffered an undiagnosed attack of typhoid fever in the autumn of 1927. During the next three years there occurred some seventeen cases, with two deaths which could be traced to him with reasonable certainty. Some of these were contact cases in his household, but the majority were milk-borne and over half came via the cheese factory where the milk which he produced was processed. It is unfortunate that pasteurizing milk softens the curd, so that as yet the cheese makers cannot produce with it the hard Canadian Cheddar on which our export trade is built.

Last autumn a sharp outbreak of typhoid occurred in one of the cities in my district. There were some twenty-five cases, with three deaths. Investigation showed that these cases were dotted along one raw milk route like beads on a string. Faeces samples were taken from all at the dairy and at the four farms whence the milk came. They were negative. One man employed at one of these farms the previous month was followed to his home and his faeces were positive. The farmer had had him only for the month of August and had used him as a milker on but three or four occasions. This man, sixty-three and not too brilliant mentally, had been a farm labourer all his life, but was of a type that one would not expect to see employed very long at any one farm. Inquiry showed that he had had typhoid at least twenty years ago and that since then cases of typhoid had cropped up where he was employed.

Tuberculosis of the bovine type has perhaps the richest literature of all diseases transferrable by milk. I cite three instances: Some five or six years ago the prize steer at the Royal Winter Fair was purchased by a leading firm of Toronto butchers for more than six hundred dollars. The carcass had to be condemned to the fertilizer tank: it was riddled with tuberculosis.

During the first half of this decade, a young clergyman came to a village in my district. No pasteurized milk was to be had for his somewhat numerous small family. He sought out the healthiest looking of the village cows for his supply. In a few weeks this cow died. A veterinary postmortem showed tuberculosis as the cause of death. Again he sought the healthiest looking cow and again she died of tuberculosis. Once more the process was repeated—in all, three times in a little more than six months.

Within the last two years, one of the strongest opponents of pasteurized milk in my own city became converted. Getting a good offer, he sold his raw milk route and, being interested in the milk business, took a trip to see a certified milk farm. His visit chanced to coincide with the reading of the semi-annual tuberculin test. Some five or seven "reactors" were found, two of which were cows in the milking line. They were all sent to the abattoir for slaughter. Here indeed was food for thought. He followed to see them slaughtered. The carcasses of both cows were condemned. In one of them even the udder was riddled with tuberculosis.

These instances, I think, sufficiently indicate the dangers that may lurk in raw milk and show how these dangers arise from the cows, the milkers and the handlers of milk. They also show that such admirable measures as establishing certified herds, etc., not only fail to protect us from infection from the human handlers of milk, but they fail to protect us entirely from milk-borne bovine tuberculosis and other animal diseases, such as undulant fever.

Dr. John A. Amyot, C.M.G., Deputy Minister of Pensions and National Health, Ottawa.—As one who was actively engaged from the very beginning in forwarding the movement for pasteurization of milk, the presentation of papers to which we have just listened has been a matter of very great interest to me. It would appear that in spite of the earnest preaching of the gospel of pasteurization for the last twenty years, we are still compelled to reiterate

all of the old arguments, as pertinent now as they were in the years gone by. Reports on the beneficient action of pasteurization in reference to the control of infant mortality and the spread of certain infectious diseases amongst adults as well as children, should convince the most sceptically minded persons of the great advantage to health following this method of treating milk.

The idea that pasteurization damages the nutritional quality of milk for the feeding of infants, is unquestionably a bogey, inasmuch as recent scientific investigation goes to show that the vitamins contained in milk are practically undamaged, only vitamin C being affected, and that in partial degree only, and the small loss of this can always be made up by the administration of orange juice, or juice of tomatoes. It has also been proven that the calcium salts of the milk, which enter into the production of bone formation in infants, remains unaffected by pasteurization.

The old cry on the part of producers that pasteurization raises the cost of milk to the consumer, does not exist in actual fact; on the contrary, it has been shown that the large losses that occur in the handling of raw milk are practically done away with by pasteurization, resulting not in a loss, but instead, a considerable margin of profit to the producer.

Another thought comes to my mind, and I would utter a word of warning to all health authorities not to be led, in these days of food propaganda, under pleas of expediency or otherwise, to boom increased milk consumption among children without taking all necessary steps to assure that such milk is efficiently pasteurized.

I would like to point out at this juncture the false security that may be engendered by the use of the tuberculin test on herds. This test alone, so far as it goes, is, of course, a step in the right direction, but it is a well known fact that quite frequently cases of tuberculosis are missed, and, to my knowledge, in the past dairymen have even deliberately held back from slaughter some one or other valued animal, even when it was shown to be a reactor, thus seeding down again an otherwise healthy herd with tuberculosis.

In regard to the occurrence of infectious abortion in cattle, a disease readily transferable to man, it has been estimated by officials of the Department of Agriculture that at least about twenty per cent of all milch-cattle in Canada are infected, thus providing a further and pressing argument to continue our endeavours to establish pasteurization in all communities.

Septic sore throat conveyed by milk has been ably shown by one of the speakers as a source of considerable anxiety to health authorities, as witnessed by the recent epidemic at Kirkland Lake, Ontario.

With the better general control of typhoid and diphtheria, combined with pasteurization in our larger communities, milk-borne epidemics of these diseases have very nearly reached the vanishing point. Such instances as do occur, with the exception of the Montreal epidemic of typhoid fever, are largely confined to smaller communities, where pasteurization is not in vogue.

In closing, I would just like to say that I am as enthusiastic an apostle of pasteurization as I always have been, especially in the light of our present knowledge of infectious diseases which may be conveyed from milk to man, and I wish to emphasize the fact that *no* raw milk supply can be considered a safe one, not even certified milk. For it has been demonstrated that epidemics of intestinal infections have been traced to contaminated supplies, and that infectious abortion is as frequent amongst herds producing certified milk as in others, with resultant infection of human beings. By all means let us have thorough-going and efficient pasteurization of *all* raw milk in all communities until this is done, the public health will always be endangered.

Dr. J. W. McIntosh, B.A., M.B., D.P.H., Medical Health Officer, Van-

couver, B.C.—The essentials brought out in this discussion on a safe milk supply may be expressed in the following points:

1. The imperative need for pasteurization, in toto, of the milk supply.
2. The necessity for structural standards, established by the government, for pasteurizing equipment.
3. *Closer supervision.* With 100 per cent pasteurization, pasteurizing plants will require even closer supervision than do dairy farms.
4. The importance of dependable laboratory tests.
5. From the standpoint of the producer, the two essentials are:
   (1) To know how to produce bacteriologically clean milk.
   (2) To have an inducement to apply his knowledge continuously.

This can best be brought about by the publication of a six months' average of each producer's bacteriological counts. This has been done successfully in California. Seattle, by this means, had a 75 per cent improvement in their milk supply during the last half of 1930. To bring this about requires the education of the public who in turn can hold their municipal representatives to the demand, first and foremost, for safe milk including the pasteurization process. My personal experience abundantly shows the necessity for this.

Last year in Vancouver we were unable to impugn our milk supply for any cases of communicable diseases except undulant fever, of which thirteen cases were reported. That undulant fever is much more prevalent than is generally recognized seems very likely, it being masked under typhoid fever, ill-defined fever, and even tuberculosis, as in one case that came under my personal observation, the doctor in attendance hesitating in his diagnosis between typhoid fever and tuberculosis.

"Raw Milk is Contaminated Milk"

TO my mind this is what should be stressed to the public—the fact that raw milk is not pure milk; that it is contaminated milk; and that in order to make raw milk safe milk, it must be treated by heat, as in pasteurization. If we could only adopt the word "contaminated" instead of the word "raw," our task would be much easier.

While pasteurization is of paramount importance, we must not overlook the fact that the most scrupulous cleanliness from every point of view should be observed in milk production. Remember this, and place it on a placard in your dairy, "Pasteurization will not clean dirty milk." Pasteurization deals with bacterial contamination. Sanitation deals with physical contamination. Both must be observed and scrupulously carried out in order to give the most desirable results in the product.—*Dr. W. J. Bell, Deputy Minister of Health, Ontario, Canadian Public Health Journal, Vol. XX. No.* 11. *Page* 531.

The Place of the Engineer in Milk Control Programmes*

R. H. MURRAY, C.E.

Director of Sanitation, Saskatchewan Department of Public Health

THE public health engineer's greatest contribution to sanitary science in the past has, without question, been in bringing the incidence of typhoid fever down to an almost irreducible minimum by the installation of water and sewage treatment plants. And having installed these plants he cannot sit back and rest, for he must maintain constant supervision over them: the danger against which they protect the public is ever-present and will break out in epidemic form if his vigilance is relaxed.

But strict as must be the supervision over a city's water supply, what of its milk supply? A public water supply is usually obtained from one definite source at which the necessary treatment to render it safe may be applied. A city milk supply comes from several hundred sources—in Toronto and Montreal, from several thousand. The water supply mains leading to the city are generally only a few miles in length, are underground and completely protected. The channels by which milk is brought from producer to consumer are often more than one hundred miles long and are exposed to contamination, if not infection, at numerous points.

More important still, bacteria tend to die in water, whereas they thrive in milk. Water becomes safer through storage in lakes and reservoirs in which bacteria, by a wise provision of nature, are in time eliminated; but not so with milk. Nature did not intend milk to be consumed in any way other than direct from the animal. The organisms of diphtheria and typhoid multiply in milk at alarming rates.

In water, germ life is eliminated by the natural processes of aeration, sedimentation, dilution and sunshine; in milk these purifying factors have no place. Milk, like water, is consumed in every home in the community and it has become an essential in the daily life of civilization.

It might be argued that the quantity of milk consumed is only one quarter of the amount of drinking water used but of what significance is that if the dangers of infection are four times as great?

Here then, we have a problem demanding the concentrated effort of our sanitarians and although the public health engineer cannot alone solve every feature of the milk problem he can contribute very materially to that end.

Typhoid fever, as we have already remarked, is a disease which has concerned the public health engineer more closely than any other. For many years the standard treatise on "Typhoid Fever, its Causation, Transmission and Prevention" was that written by George C. Whipple,

*Presented at the C.P.H.A., Annual Meeting, Section of Public Health Engineering, June, 1931.

one of the foremost consulting engineers on this continent. In his preface to this work Whipple says:

> "The fight against typhoid fever must be made largely by men of two professions, by physicians and engineers. Differences in temperament, in training and in the nature of their work have prevented these two professions from co-operating as closely as they must if typhoid fever is to be relegated to the class of infrequent diseases. The doctor naturally thinks of men as individuals: he is not accustomed to think of men in masses.
>
> "The engineer, with his genius for mathematics and statistics, studies communities at large, and is in danger of neglecting to study the details of particular cases. The two professions admirably supplement each other. The engineer is by training the best fitted to control the measures which are instrumental in warding off disease, while the physician is best fitted to attack the disease in the household."

If the public health engineer is to appreciate and investigate all the channels through which a typhoid epidemic may arise, he must be familiar with every phase of the production and processing of a public milk supply.

Although the incidence of typhoid fever is now happily amongst the lowest of our communicable diseases, small outbreaks still occur periodically in the best regulated municipalities and there is still that tendency on the part of the local medical health officer at once to suspect the water supply. Typhoid and infected water supplies were so inseparable when the health officer received his early training that he cannot disassociate them. The health authority would in most cases be much nearer the mark if he were to investigate his local milk supplies and look for a typhoid history amongst those persons who are engaged in handling the milk.

In most provinces the control of milk supplies was originally vested in the Department of Agriculture. It is now generally accepted that departments of agriculture are not concerned with the safety of milk supplies but their function is to encourage the dairy industry and to give advice and assistance to farmers in the matter of quantity production. The health department is the controlling authority in all matters of quality, and the laws and regulations affecting the safety of the supply, methods of production and standards, emanate from that department.

The question then arises as to what branch or division of the health department is most intimately concerned with milk control.

Consider for a moment how many types of trained health officials are necessary to ensure that when a quart of certified pasteurized milk reaches the consumer it conforms to the required health standards.

The veterinarian must apply the tuberculin test to the dairy herd and satisfy himself that the cattle are healthy. The physician must subject the dairy employees to a medical examination. The milk inspector must investigate and report on the sanitation of the dairy

premises, the condition of the utensils, and the methods in use. The chemist must test the milk for butter fat and total milk solids. The bacteriologist must determine the bacterial count and the public health engineer must examine and advise upon the processing and pasteurising of the milk at the depots.

Thus we have six sanitarians, all of whom are indispensable to the production of safe milk. The contribution of the public health engineer to the general sum of protective supervision is perhaps no greater than that of any of the other five, but his training and experience in supervising municipal water supplies; in meeting public bodies and appreciating practical issues, rather than academic findings; in controlling measures for the public interest rather than dealing with the individual: these things give him a proper perspective and render him a suitable official to undertake milk control activities.

We have travelled a long way since the picturesque days of the dairymaid who went a-milking with her three-legged stool. Today the milk-maid has been replaced by milking machines; the cows are fed and watered by mechanical devices; in some cases, the very stalls in which the cows are milked are mobile. The milk is cooled by special apparatus, utensils and containers are sterilized by steam and other processes and the milk is conveyed by motor truck or train to the depot where it is weighed, pumped, clarified, pasteurized, cooled, bottled, capped and placed in refrigeration. Thus has milk become mechanicalized and it would be difficult to say at what stage of its production and processing the engineer is not concerned in its control.

Pasteurization is now an essential to safe milk supplies in cities. And this fact being accepted, it has been realized that pasteurization must be efficient—every part of the milk must be heated to the required temperature for the proper period. This seems a simple matter, but investigation by public health engineers has proved otherwise. We are all familiar with the studies which have been made by engineers of the United States Public Health Service and of city and state departments of health, studies which have shown the dangers arising from defective valve construction, excessive length of milk piping, cross connections, pumps, thermal recorders, foaming, and numerous other features of pasteurization. Like chlorination of water, pasteurization is the final safeguard of a city's supply and if it is not carried out under rigid and scientific supervision, public confidence in its health officials is betrayed.

A few weeks ago that outstanding milk authority, Milton J. Rosenau, Professor of Preventive Medicine and Hygiene at the Harvard Medical School, addressed the American Association of Medical Milk Commissions and he had this to say about pasteurization:

> "Pasteurization is a perpetual surprise. We think it settled, but like Banquo's ghost it crops up again and again to plague us. It is the simplest, safest, surest and cheapest life-saving process in the whole realm of preventive medicine, yet it bristles with difficulties and problems. We

give so much time and trouble to perfecting the process because pasteurization is so effective and so beneficient.

"At first glance it seems the easiest thing in the world to pasteurize milk. All we have to do is to heat it to a certain temperature, hold it there by the watch and then cool it. It is nothing more or less than an every-day operation in the kitchen, but on a large and precise scale.

"Experience, however, shows that so simple and practical a problem in physics as the exact heating, holding and cooling of a fluid is fraught with perplexing problems. There is no difficulty whatever in heating and cooling a small quantity of milk in a test tube under accurate conditions in a scientific laboratory. The difficulties appear and grow and multiply when we apply the results on a large scale under varying conditions in industry. It is a constant matter of surprise that something that seems so simple and easy should in practice become complex and perplexing. The reasons for this paradox are apparent when we study the causes of the failures, the blunders and the disappointments that have strewn the pathway of this useful process all along the road.

"Pasteurizing apparatus and methods have grown up like Topsy. The industry has blundered through with machines and processes as they were designed, manufactured and marketed, only to meet with disappointment and unnecessary expense.

"Pasteurization is with us to stay. The problem is as much alive today as ever and even more debatable. There is a plentiful lack of understanding concerning the process and its objects. At one time it was difficult to know whether pasteurization was a badge of honour or a mark of disgrace. This period, happily, has passed and dairymen now proclaim pasteurized milk in bold letters, realizing that it is the best insurance for the industry and the best protection for the public."

Some years ago when the Department of Public Health in this province instituted an investigation into the methods under which city pasteurizing plants were operating, it was found that in almost every instance the operator at the pasteurizing vat was entirely ignorant of the health significance of the task assigned to him. Whether the milk was raised to 140 degrees or 145 degrees or held for 20 or 30 minutes was a matter of indifference to him.

In one city plant which outwardly was beyond criticism and in which the walls were white tiled, the employees dressed in white suits and caps and no expense spared in impressing the public with the excellence of the supply, the raw milk was pumped up to the pasteurizing vat where it was held at the proper temperature for the correct period of time. The valve was then opened and the pasteurized milk was pumped to the cooler by the same pump and through several lengths of the same pipe through which half an hour before the raw milk had passed!

I do not say that a physician, chemist, bacteriologist, veterinarian or milk inspector would fail to note a vital defect of this nature, but unquestionably the examination of pipes, pumps, valves and fittings comes naturally to the engineer and he is more likely to detect such irregularities.

It is now provided in most provincial milk regulations that before

a new pasteurizing plant can commence operations the plans shall be submitted to the Provincial Department and the equipment, arrangement of apparatus, methods and treatment employed shall be approved.

This procedure involves examination of blue prints and practical knowledge of the essentials of the safe processing of milk, and in such matters the advice of the engineer is invaluable.

Then there are the dairy buildings, the ventilation of cow barns; a dairy herd cannot be healthy if housed in poorly ventilated barns. Air conditioning is the province of the engineer. Another subject is the sterilization of milk containers and utensils. At this very convention a paper is being presented on "Studies in the use of chemicals in milk bottle washing," by an official of the Division of Sanitary Engineering of the Ontario Department of Health.

Those of us who have been reading that excellent new journal known as "Municipal Sanitation," published primarily for engineers, will have noticed that considerable space has been devoted to the subject of milk control. We have only to glance at the Public Health Engineering Abstracts issued by the United States Public Health Service to realize how important the subject is to the engineer. At the recent convention of the American Society of Civil Engineers a committee of the Sanitary Engineering Section reported on milk control. Everywhere we have evidence to encourage us in studying the milk problem.

Personally I am convinced that the public health engineer cannot disassociate himself from municipal milk control activities—on the contrary these activities cannot be engaged in efficiently unless the engineer takes a large share in solving the various problems which they present.

Practical Points in the Production of Clean and Wholesome Milk

A. R. B. RICHMOND, D.V.M.

Department of Health, Toronto

MILK properly drawn from healthy cows, with rigid hygienic precautions and delivered to the consumer in a short time, is free from disease producing organisms and is an ideal food. The problem of securing clean milk; *i.e.*, milk as near as possible to the condition as it exists in the udder, is the problem of dairy sanitation. To put it in another way, it is the problem of reducing to a minimum contamination from all outside sources. Many cows, however, are not properly milked; many herds are not free from disease; many farmers have but little knowledge of the necessity for the observance of sanitary and hygienic methods; and but a small proportion of milk coming into any city of considerable size can be delivered to the consumer soon after milking.

How Milk is Contaminated

If the mere presence of solid particles of dirt so frequently found in milk were the only damage wrought, the question would resolve itself into the simple operation of straining the milk. The presence of solid dirt is, however, an indication of much more serious conditions.

Bacteriology teaches that every particle of dirt, whether it seems to the eye a source of contamination or not, carries with it great numbers of bacteria, and that milk at ordinary temperatures, 65 degrees F. to 100 degrees F. is an excellent medium for their growth, and most of the changes which take place in milk can be traced directly to such action. Neither straining nor clarifying will remove bacteria from milk; hence the necessity of keeping the dirt out, not straining it out.

From the act of milking to the final consumption of the milk the possibilities of contamination are many and varied in character. Everything that comes in direct contact with the milk may be a source of trouble, and many things may act indirectly and seriously affect the results desired.

Contamination usually begins with the act of milking. If the flanks and udder of the cow are covered with the dirt of the yard and stable the process of milking will dislodge a greater or less portion of the filth, causing it to fall into the pail. The amount of dirt that will be on a cow will depend very much on the conditions of the stable yard and the floor, gutter, and bedding in the stable. As to the amount of filth that will get into the milk and its effect on the product, reports from investigators show that "the average weight of dirt which falls

from muddy udders during milking is 90 times as great as that which falls from the same udders after washing, and when udders are slightly soiled it is 32 times as great. Wiping the clipped flanks and udder of the cow with a clean damp cloth just before milking is a very efficient method for reducing the bacteria which fall into the milk pail."

The milker may not be clean in person or dress; he may have that most filthy of habits, milking with wet hands. The hands are usually wet by milking a few streams over them, and kept wet by repeating the operation as milking proceeds. The filth on the udder will ooze out through the fingers and drip into the pail. This condition was at one time quite frequently met in inspection work.

Milkers too often wear clothing that has done duty for every other work about the farm. Such clothing may contain dirt from the hog pen, the chicken coop, the horse barn or the swill barrel, and is entirely unfit to be worn during milking.

A clean washable milking suit has a twofold effect. It will not of itself contaminate the milk, and if the milker is required to keep such a suit clean, he must of necessity keep clean everything with which he comes in contact.

The difference in results between different milkers working under the same conditions is strikingly illustrated in the following extract from a report issued from an agricultural experiment station:

"The average of 19 tests with two milkers who had had no training in dairy sanitation and one milker who was a graduate of an agricultural college showed 17,105 bacteria per cubic centimeter for the untrained men, and 3,455 for the trained man. The only difference between the men was the knowledge of what constituted contamination, gained by the college graduate, who was a student of bacteriology."

Education and Regulations

This example illustrates the difficulty encountered in securing clean milk by means of regulations only. Education must go first, and the law behind the regulations should be used only in cases where the individual concerned persists in wilfully disregarding sanitation when he knows better. But little will come through regulations requiring clean cows, clean milkers, and clean methods of milking, and of handling the milk, unless the producer understands the object of such regulations and the effect they will have on his work. Those in charge of inspection must be teachers first, and law enforcers only when they find that the producer will not live up to the instructions given him and his knowledge of what is right.

Regulations intended to correct evils often fail in their purpose because of injudicious administration on the part of health authorities, but much oftener from the fact that a man who is by nature filthy in his habits cannot be legislated into cleanliness. If he is content to drink at his own table milk that contains only a little cow dung, he

takes it as an infringement on his personal rights and liberties if the authorities attempt to compel him to keep such material out of the milk that goes to his neighbours.

Utensils

The milk pail should be made so as to reduce to a minimum the amount of dirt and hair that can get into it during the operation of milking. The narrow top in some form or other is the most satisfactory, and will undoubtedly in time entirely replace the wider top. Pails and all other utensils designed to hold milk should be seamless if possible, and where seams must occur, they should be flushed full and smooth with solder. There should be no place either inside or out that cannot be reached by the brush in washing. Heavily tinned utensils are recognized as the best for milk purposes. Wood, galvanized iron, or any material that is rough or porous is unfit for milk vessels.

No important part of the dairy work is so often neglected as the cleaning of the milk utensils. It cannot be too strongly emphasized that dairy utensils must, after the milk is washed from the surface with warm water, be scalded with boiling water or steam. Nothing short of this will insure clean milk.

The Barn and the Cow

The proper location of a dairy stable is a most important consideration. Good air, adequate drainage, plenty of sunlight and an abundant water supply are essential features. The stable should be situated among surroundings that afford a good natural drainage, and when new buildings are to be erected, where possible the barn should run east and west, thus providing for a south exposure which is so very desirable during the long winter months. No producer can afford to house his cows in a dark, damp or forbidding stable if he is in the business for profit and satisfactory results. Above all other domesticated animals, the cow responds quickly to the kind of treatment she receives. The limit of her profit is measured by the care and the surroundings given her. The stable should be substantially and tightly constructed, and all interior surfaces made as smooth as is possible and practicable. A properly laid floor is of great importance in a sanitary barn. It must be constructed of non-absorbent, smooth-surfaced material, preferably cement. It must be provided with adequate surface drainage and be capable of being satisfactorily cleaned. The platform should be just wide enough to comfortably accommodate the animals, and may vary a little according to their size. The gutter may be a little less than a foot deep and about a foot and a half in width. This kind of standing and gutter will help keep the cows clean.

To be maintained in a strictly clean and sanitary state, a dairy stable must be well whitewashed throughout at least twice a year.

The contrast between the old time stable, where the spider hung his drapery of cobwebs from every projection and in every nook and corner, and the modern clean, whitewashed, convenient stable is very marked. Whitewash is an abomination to the spider, and is of inestimable value in dairy barn sanitation.

Under no consideration may any other animals than those comprising the dairy herd be kept in or allowed the run of the dairy barn. Poultry and pigeons must also be kept out.

As essential as pure, wholesome food to both man and animals, is pure wholesome air, and too much emphasis cannot be placed upon both ventilation and sunlight for a dairy barn, not alone for the benefit of the dairy animals, but also for the warmth and cheer brought to the worker in carrying out his daily duties, particularly during the winter.

The practice of shaking up bedding and the throwing down of feed from the loft just before milking is, for obvious reasons, wrong.

A clean dry yard plays an important part in controlling the cleanliness of animals. Where cows are obliged to wade through mud and manure up to the hocks and belly they are not only smeared and plastered with filth—which usually in the hands of producers who allow such conditions to exist, is not washed off—but they are subject to disease of the hoof and skin directly dependent upon such conditions. A good producer overcomes these conditions by not allowing any manure or stable filth to accumulate in the stable yard, and by providing for adequate drainage, by grading if necessary, and the treating of the yard surface with gravel or other suitable material.

Milk is a suitable medium for conveying many forms of communicable diseases of animals and man. The pathology, or study of the cause and nature of these diseases of milk, therefore, would involve a study into those conditions which are reported as primary to the propagation or dissemination of disease, both on the ground that milk is a fertile culture medium as well as a convenient vehicle. The maintenance of a healthy herd is a most potent factor in a sanitary milk supply, and to maintain one requires both careful supervision and regulation. A careful, thorough physical examination of all animals should be made as often as possible, and all external appearance of disease should be taken carefully into consideration. All workers engaged in the production of milk must be free from disease, for, owing to its susceptibility to contamination, milk is often rendered a disease carrying medium.

The Milk House

Next in importance to clean milking is proper cooling. This should be done immediately after the milk is drawn from the cow, inside a clean milk house, situated within clean surroundings. The bacterial content at any time depends upon the age of the milk, the initial number of bacteria introduced through the process of production and handling,

and the temperature at which the milk has been kept. It is most important, therefore, that the milk be chilled immediately after milking to a temperature of not higher than 50 degrees F. and held at that temperature or lower until consumed.

Hauling to the depot, holding at the shipping point, transportation over the railway or by motor truck, and the handling in the city plants, are all steps in the process of supplying a city that need intelligent and conscientious care.

The milk house should be entirely separate and at a reasonable distance from all other farm buildings. It should be located as conveniently as possible to the dairy barn, preferably on the windward side so that dirt and dust will not so readily reach it, and consideration should be given to convenience in loading the milk for the dairy plant. The site selected should be well drained by being if possible a little higher than its surroundings, and the ground around must be kept in a strictly sanitary and tidy state. The milk house must not be located in the stable yard or adjacent to the stock watering trough.

The size of a milk house depends upon the quantity of milk to be handled. It should be neither too cramped nor too large, and in its planning care should be taken to make certain that it is large enough to care for a normal increase of the herd.

It must be used for no other purpose than for that which it is provided; *i.e.*, the chilling and storing of milk from the time of milking until shipment and the storing of empty milk cans and dairy utensils.

There are many different plans for milk houses but probably the most satisfactory are those which show a concrete floor and splash base, with a milk chilling vat of the same material, and with a wooden frame and roof, such construction requiring the smallest initial expenditure consistent with good construction practice. Concrete, stone or tile may, of course, be used in place of the wood, with the assurance that good construction of this type will give perhaps greater satisfaction in the matter of sanitation, temperature regulation, cost of upkeep and length of life, but whatever material is used success depends upon the scrupulous cleanliness observed, and under these conditions wood is quite unobjectionable.

All interior surfaces of the milk house must be smooth and painted white. Window and door construction should be arranged to provide for adequate light and cross ventilation and all doors and windows made to open outwards. The door should be fitted with some satisfactory self-closing device, and all openings through which flies and dust may gain access to the milk house must be perfectly screened.

An adequate cold water supply, preferably from a spring or well, must be assured, and augmented by ice in order that the water in the chilling vat be kept at a sufficiently low temperature.

The chilling vat should be provided with a tight wooden cover, which will tend to hold the water at an even temperature, and may be

sunk in the ground approximately 12 inches below the floor, by which the lift in handling the cans to and from the vat will be decreased. Angle irons set in the concrete on both the outside and inside edges of the front wall of the vat will prevent the concrete from chipping as cans are lifted from or into the vat. A wooden sill may be bolted on for the same purpose, but it will not be found so satisfactory.

Circulation under the cans can be had only by either the construction of deep corrugations in the concrete, or by a rack placed in the bottom of the vat.

Very satisfactory circulation of water through the vat may be had by having the inlet pipe enter near the bottom and at one end, and the overflow drain open near the top of the vat and at the opposite end. In this way the cold water rises to the top taking up the heat from the cans, and is also flowing from one end of the vat to the other. The height of the overflow drain should be adjusted to hold the level of the water to within about 3 inches of the top of the cans.

Some proper means must be provided for the draining and cleaning of the vat, which, needless to say, must always, along with the whole interior of the milk house, be kept in a scrupulously clean condition. A metal plunger should be used for stirring the milk in the cans while chilling, and a suitable metal rack erected within the milk house, upon which all empty cans just as soon as received from the dairy should be replaced, inverted, with lids removed, for airing and storing until placed in use. At all other times, with the exception of when the milk is being stirred, the lids should be kept tightly on the cans.

Conclusion

The foregoing are a few practical points which should be of interest to any public health authority contemplating the organization of a dairy-farm inspection system.

There are matters such as the testing of animals for tuberculosis and a contagious abortion; the installation of milk chilling and utensil sterilizing faculties; the drawing up of score-card systems of farm inspection, etc., which might be gone into with considerable detail and which would prove of interest and value. A vast amount of information on above subjects is available, however, from the federal, provincal and many municipal departments of health and agricultural and veterinary colleges, which may be had upon request and there is really no legitimate reason why anyone should be ignorant—as so many are—of the smallest detail in connection with the production and handling of this food.

Education—elementary, advanced, technical, practical and popular—must be depended upon to unlock the doors of ignorance and let in the light and air of hygiene equally as fully as other branches of human knowledge. The knowledge acquired by education must, ultimately and alone, be trusted to bring to the individual and to the community that the acquisition of health is the acquisition of wealth.

Tests for Quality in Milk*

H. R. THORNTON, M.Sc., PH.D.

Professor of Dairying, University of Alberta

IN 1917, four dairy bacteriologists in the United States defined milk quality as including food value, healthfulness, cleanliness, and keeping quality.

The public health official is interested primarily in food value, healthfulness, and cleanliness. To a lesser extent he is indirectly interested in keeping quality because it has a slight bearing on the first three factors. The milk distributor is interested primarily in keeping quality and to a much lesser extent in those things of paramount importance to the public health worker.

Most of the tests giving the information in which the public health department is mainly interested, particularly the isolation and identification of pathogenic micro-organisms, are so cumbersome and expensive that they are seldom employed (routinely) on the general milk supply. Such tests include the identification of B. tuberculosis, B. typhosus, Streptococcus epidemicus the causal agent of septic sore throat, Brucella abortus, and numerous others. As an illustration let me cite the case of the coliform organisms. A positive test for B. coli in milk does not have the same significance that it does in water because probably no milk is ever produced in practice, even certified milk, which does not contain fecal contamination. B. coli grows prolifically in milk. Its source is the bovine intestine, hay or grain, and it is therefore no indicator of the possible presence of B. typhosus. Again, may I cite the case of Streptococcus epidemicus. The bi-monthly examination for this organism of the milk from the individual cows supplying the city of Chicago with certified milk requires the services of at least two full time laboratory workers. Since the certified supply probably constitutes less than 1 per cent of the entire milk supply, you can readily appreciate that two hundred laboratory workers would be required to give an equivalent control of this disease alone for the general milk supply of that city. It is no wonder that certified milk is twice the price of ordinary milk. The public health officer has available, however, a very simple and efficient means of control as far as pathogenic organisms are concerned. I refer to pasteurization.

On the other hand, there are a number of simple and inexpensive laboratory tests for keeping quality. Because of its complexity it is almost impossible to define keeping quality. Any definition is necessarily an arbitrary one. In general, the expression means the period necessary for a degree of acid production sufficient to be measured by taste. This is not only a very relative and inaccurate measure but is exceedingly one-sided, since acid is but one of a number of products

*Presented at the Annual Meeting of the Alberta Health Workers' Association, June 12, 1931.

of bacterial metabolism. It not infrequently happens that bacteria are very active in a sample of milk, with no consequent increase of acidity. Therefore, an enumeration of the bacteria in a sample of milk is a more nearly perfect index of the bacteriological condition of the milk than is any present test for keeping quality. But let me emphasize that quantitative bacteriological milk tests give little or no information regarding types of bacteria.

Because the qualitative tests are cumbersome and expensive while the quantitative tests are relatively simple, reasonably accurate and inexpensive, public health workers have adopted the latter, frequently to the entire exclusion of the former. A discussion of the soundness of this practice is probably out of place in this paper. That the practice is general cannot be questioned. Because of the universal use of these quantitative tests by public health departments on this continent a discussion of their technique and limitations is pertinent.

The American Public Health Association's Standard Methods of Milk Analysis recognizes four methods of estimating bacterial milk populations, viz.:

1. The Macroscopic Colony Count or Petri Plate Method.
2. The Microscopic or Breed Method.
3. The Microscopic Colony Count or Frost Method.
4. The Methylene Blue Reduction Test.

The Frost Method

For various reasons this method has not become very popular or widespread. It is subject to most of the weaknesses of both the Breed method and the Petri plate method. On the other hand it has some of the advantages of both.

The Methylene Blue Reduction Test

This test depends upon the decolourization of methylene blue from milk on incubation. The reduction of the dye is caused by certain constituents of the milk itself, and occurs when a certain electric potential is reached in the milk. The potential is governed by the amount of dissolved oxygen in the milk. This in turn is controlled by the bacterial activity. Thus in a milk containing a large number of actively growing bacteria the oxygen is rapidly consumed and the potential then falls through the range of the methylene blue, which is reduced not by the bacteria, as is claimed in most of the earlier literature, but by milk constituents. In a good milk of low bacterial content the oxygen is consumed much more slowly and the reduction time is lengthened. Therefore, the length of time necessary to reduce methylene blue is a measure of the bacterial activity in the milk.

Like all other biological tests this test is not 100 per cent perfect.

The two main sources of inaccuracy are probably:

1. The different oxygen consumption rates of different species of bacteria.
2. The sweeping of the bacteria out of the body of the milk by the rising butter fat.

Because these inaccuracies probably follow the logarithmic growth curve of bacteria, Hastings and I have recommended that this test be not considered accurate after the 5½ hour period as laid down in Standard Methods of Milk Analysis. The Assistant Dominion Bacteriologist, Mr. C. K. Johns, questions this time period and says that it should be extended to about 10 hours. Without engaging in any controversy here, I would like to say that I believe his own data bear out our contention.

The methylene blue reduction test is simple, inexpensive and the only bacteriological test sufficiently fool-proof to warrant placing in the hands of untrained workers. It has the advantage that duplicate tests check, whether run by one or more workers. It is by far the most inexpensive of any of the official tests, costing probably about five cents a sample.

Since it should not be read after the 5½ hour period, it is limited to the differentiation of middle class milks. This means that when a milk supply has attained such a quality that it takes over 5½ hours to reduce methylene blue, another control method must be adopted. This is the situation today in both Calgary and Edmonton. Ninety per cent of the milk arriving in Edmonton does not reduce methylene blue in this time. If further improvement is to be made, and it should be recognized that a 5½ hour milk is not a particularly good one, another method must supercede the methylene blue test. If we disregard the Frost method, this leaves us the choice of the Breed method and the Petri plate method.

The Breed Method

In this test a minute quantity of milk is measured on a glass slide, spread evenly over a measured area, stained, and the individual bacteria are counted under a microscope. On first thought this would appear to be the ideal method but when it is considered that a milk containing 50,000 bacteria per cubic centimeter would show an average of but one cell per 10 microscopic fields, the difficulties of the technique are obvious. These difficulties limit the test in practice to about the same classes of milk as are applicable to the methylene blue test. The cost of training workers in the microscopic technique is high. The cost of a microscope, while high, is not prohibitive.

To offset these disadvantages are a number of advantages. The test is fairly rapid and not as expensive as the Petri plate method. It fits into any laboratory routine. A permanent record is made avail-

able. But above all, it affords some qualitative information. It is sometimes possible to diagnose certain production troubles by a microscopic examination of the milk. At least one type of udder trouble, mastitis, results in a milk the microscopic picture of which is sufficiently characteristic and distinctive to arouse suspicion.

In general the Breed technique is slowly finding its place in milk control work. More extensive use of it is warranted. However, it has by no means supplanted either the methylene blue reduction test or the Petri plate method.

The Petri Plate Method

This is probably the most extensively used of all methods available to the dairy bacteriologist. It seems to me that it is significant that it has survived to this extent in spite of the fact that it is the most costly of the four methods. Harding has estimated that it costs $1.00 to $2.00 per sample of milk. While not as simple or as nearly fool-proof as the reduction test, nevertheless, when its limitations have been recognized, it has given much valuable information. As a routine test it is of little qualitative value. Quantitatively it appears to be, however, of almost equal value for all classes of milk.

Numerous controversies have been waged regarding the variability and accuracy of the plate count. Most investigators have concluded that, whatever its limitations, it has a place in milk control work. Yet it is my humble but considered opinion that many, if not most, public health workers place an unwarranted confidence in this method.

The exact accuracy of the plate count cannot be stated, for no one knows it. That the method gives results which at times are variable, even exceedingly variable, is proven beyond question. In reviewing much of the literature on this subject I find that the average coefficient of variability of the plate count is probably between 20 and 30 per cent. Instances in which this figure rises to ten times this value are not rare. Averages of different dilutions of the same milk frequently vary so widely as to make valueless the plate count for that sample of milk.

Breed and Stocking concluded that "the margin between two plate counts made from similar samples of market milk must be as great as one to five before it becomes a practical certainty that the larger count actually represents the larger number of bacteria."

This viewpoint, I have found, frequently comes as a shock to public health workers. I believe that we have nothing to lose and much to gain by recognizing the limitations of our laboratory procedures. The figures I have just given you become reasonable when we inquire into the inner workings of the test. There is no one medium known which will support the growth of all types of bacteria found in milk. Consequently we know before we make a plate count of milk that we will not be able to count all the bacteria present. For instance, Stepto-

coccus lactis, the ordinary milk souring organism, does not grow at all on standard medium. We know that each colony on the plate represents a group of bacteria from the original milk, whether that group consists of one cell or one hundred. We know that bacteria do frequently exist in milk in clumps. A study of the milk supply of two American cities showed the milk of one city to average about 5 cells per clump while the average was approximately 11 cells per clump in the milk of the other city. It is known that these clumps tend to disintegrate on agitation of the milk. Bacteria are not evenly distributed in milk like sugar in a water solution. The microscopic picture proves this. Therefore, it is not reasonable to expect that different minute portions of milk will contain the same number of bacterial cells. The wonder is that the Petri plate method gives any consistent results.

Discussion

The controversy surrounding this subject has centered upon the comparative accuracies of the different methods. The exact determination of the accuracies and inaccuracies are impossible, since each test measures a different thing and any yardstick used as a comparator is in itself inaccurate. If acid production is used as the measure of accuracy, then all the tests appear to show about the same degree of variability. Some have accused those of us who have shown the plate count to be variable, of attempting to supplant the plate method by some other method. Such people have little appreciation of the difficulties encountered in milk control work. It would tax all the methods, quantitative and qualitative, available to the dairy technologist to provide the information we would like regarding an individual sample of milk. No one test will do it. One test should not *supplant* another. One test should *supplement* another.

I have one more thought I would like to leave with you. While the techniques employed in these tests are not so difficult that relatively untrained workers cannot quickly learn the procedures, the principles involved are exceedingly complex. I know of nothing calling for more thoughtful, balanced judgment than the interpretation of the results. For this reason, whoever actually makes the tests, the interpretation should be in the hands of a trained worker who is thoroughly acquainted with the chemistry, physics and biology involved and who realizes the limitations of the methods. Informed workers realize today that any of these tests will differentiate milks into about three large groups with reasonable accuracy. Closer differentiation than this should not be attempted.

Inspection of Milk Pasteurizing Plants

A. E. BERRY, C.E., PH.D.

Director of Sanitary Engineering Division, Ontario Department of Health

MILK pasteurization is a specific process. Health officials are well aware that this treatment must be properly carried out if the final product is to justify the use of the term pasteurized. Caution is necessary to exclude those so-called pasteurizing methods which in no way assure a safe final product.

Modern milk pasteurizing equipment is somewhat complex. It is the result of much engineering study and efficient designing. Like all other equipment, it can be expected to do the work for which it was intended only when the design, layout and operation have been properly understood and followed. During recent years there has been a clearer conception of the importance of certain details of this equipment. Careful supervision of the equipment and the process is indispensable.

The inspection of milk pasteurizing plants should have for its objective the elimination of any defects in design, lay-out or operation. It must be recognized that the process is not merely one of heating the milk to the required temperature; rather does it include the entire handling of the milk in the dairy plant. It is of little value to heat milk if it is to be subsequently handled in such a manner that contamination may take place.

The inspection of a pasteurizing plant should involve all points which may affect the final product. The process, plant layout, piping arrangements, inlet and outlet valves, cold pockets, foam formation, recording thermometers, bottlers, cappers, cleansing of utensils and health of personnel require special attention.

Plant Layout

A well laid out milk plant not only greatly facilitates milk handling, but it also assists in the protection of the product against contamination, and in the maintenance of low plate counts. The milk inspector cannot expect to secure radical changes in the arrangement of existing plants, but he can aid where new plants are under consideration or where old plants are to be remodelled.

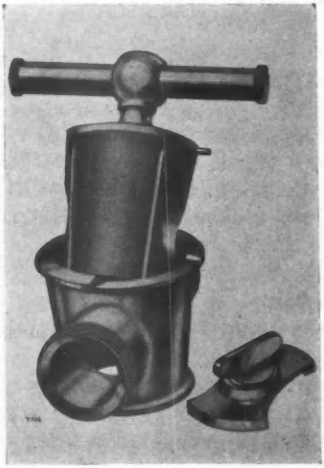
A comparison of the gravity type of milk plant with that in which pumping is necessary shows that the former has many advantages. The gravity plant requires an elevated floor on which the pasteurizers are placed. This is the arrangement found in most of the large plants, while the smaller ones pump the milk from the pasteurizer to the cooler and bottler. The minimum handling of the milk after pasteurization is desirable. Pumps and long lengths of pipe are difficult to clean properly, and tend to increase the bacterial counts. A gravity flow, through short lengths of pipe, is best. The piping should be taken down daily and thoroughly washed to prevent bacterial multiplication.

Pasteurizing Process

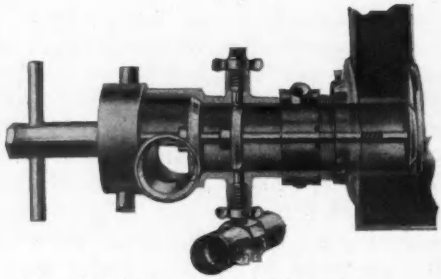
The pasteurizing process is carried out in a variety of ways at different plants. The difference is chiefly in the temperature and the holding period. The temperatures range from 140° to 145° F., and the holding periods from 20 to 30 minutes. While these lower figures may, under certain conditions, be satisfactory, it is very desirable always to have an adequate safety factor. For this reason, pasteurization at 145° F. for 30 minutes is now being required in most plants where modern standards are met. This temperature and holding period should not materially, if at all, interfere with the cream line.

Piping Arrangements

The arrangement of the piping system in a milk plant is a very important matter. Cross connections between the raw and treated milk tend to result in unfortunate accidents. Instances have occurred where raw milk has been run through the same piping system through which the pasteurized supply was passed later. In other cases, the piping system has been laid out in such a way that any mistake on the part of the operator between valves or pipes may lead to contamination of pasteurized milk with the raw product. These connections are similar to those which may occur in water-works systems. The installation, however, of cross connections in water-works plants is strictly forbidden by government regulations. Such connections in milk processing plants are equally hazardous and should under no circumstances be permitted. In his visits to a plant, the inspector should thoroughly satisfy himself that no opportunity is at hand for raw milk to come in contact with the pasteurized product, either by flowing through the same pipes, or by any arrangement whereby the operator may accidentally permit any mixing of the two supplies. The two systems should be separate entirely.



Special flush valve to overcome cold pockets.



Satisfactory type of inlet valve.

Pasteurizing Equipment

Investigations into the equipment which has been used in the pasteurizing process has resulted in the discovery of a number of serious defects. The greatest menace from these is that they may permit the passage of some of the milk without the proper heat treatment. The detection of these defects is one of the important matters for consideration by the milk inspector. The most common defects concern the following:

(*a*) Inlet valves on the pasteurizer
(*b*) Cold pockets on the outlets
(*c*) Outlet valves on the pasteurizer
(*d*) Foam formation on the milk in the pasteurizer
(*e*) Recording thermometers

Inlet Valves

Inlet valves become necessary where the milk is run from a storage tank to a number of different pasteurizing units, all connected to the same pipe line. This occurs only in the larger plants where the pasteurizers are filled a number of times daily. Under these conditions, when one pasteurizer is filled the inlet valve is turned off, and the raw milk is carried on to the next unit. If this valve leaks, and most of such valves do, some raw milk may reach the pasteurizer too late to receive the complete heat treatment. In this way the entire supply of milk in the pasteurizer may become contaminated. Fortunately a special type of inlet valve (shown in the illustration) is available for this purpose; it is known as a "leak protector valve" and is so designed that any milk which leaks past the face of the plug will drain to the floor through grooves cut in the face. If these special valves are not available, the pipe leading to the unit should be dissembled before pasteurization begins.

Cold Pockets

A cold pocket is found where the outlet valve from the pasteurizer is some distance from the vat. This distance is sometimes as great as 30 inches. Under these conditions, it is impossible to maintain the milk in this pipe line at the same temperature as that found in the pasteurizer itself. These pockets should under no circumstances be permitted. In some of the plants recognizing this danger it is the practice to draw off the first flow of milk through the pipe; they believe that in doing so they have safeguarded the rest of the supply. This is, of course, entirely unsatisfactory. Fortunately, special valves have been designed to overcome this difficulty. The inspector must pay careful attention to this matter and ensure that milk which has not been properly pasteurized does not pass out of the equipment.

Outlet Valves

Special outlet valves designed to overcome cold pockets and to prevent leakage are now replacing the old types. The danger from

the use of the old valve is apparent. These new valves can be fitted to existing equipment, as well as to new units. In the older units, a cold pocket of probably three or four inches will be unavoidable when the new valve is attached. This, however, is not a serious matter. In the new equipment no cold pocket exists. These valves are so constructed that the face of the valve fits flush with the pasteurizer lining. This eliminates any cold pocket, but, as in all metal valves, there is a tendency to leak. Any milk which leaks past this face immediately contacts with steam and then flows out to waste. Both the steam jet and the waste valve open automatically when the main port of the valve is closed. Other types of valves permit the leakage to run directly to the floor or to waste. The objective is the same in each type; namely, the prevention of partly treated milk from mingling with the treated supply.

Foam Formation

Large quantities of foam often appear on the top of the milk during pasteurization. This is caused by air becoming entrapped in the milk. This foam is almost always at a lower temperature than the milk itself and is, consequently, not properly pasteurized. Certain equipment, particularly pumps, clarifiers and piping, induces the formation of this foam. The inspector should see that the normal operation of the plant does not result in the extensive formation of foam in the pasteurizer. The manufacturer who installs equipment should be asked to guarantee his equipment against foam productions. As a further precaution it has been suggested that live steam be allowed to flow across the top of the milk in the pasteurizer during the holding period. This is an attempt to raise the temperature of the foam at least to the pasteurizing requirements.

Recording Thermometers

Recording thermometers are now found in most modern pasteurizing plants. There has been a difference in practice with respect to this equipment. In some cases it has been purchased by the municipality and the key of the thermometer retained by the dairy inspector. When this is done, the chart usually records for a period of seven days. The other type of equipment has a chart recording thermometer for a period of 12 or 24 hours. The function of a recording thermometer is to enable the inspector to determine what has taken place each time the milk has been processed. None of these thermometers is fool proof. The inspector must make sure that they record properly. They should be checked against a known accurate thermometer. In addition to this, an unscrupulous dairyman cannot be kept in check by any recording graph. It is quite easy for any milk dealer to manipulate the graph without complying with the requirements of complete pasteurization. Consequently, the theory that the recording chart should be the property of the municipality does not result in any great safeguard.

Moreover, a thirty-minute interval on a seven-day chart is of such narrow width, that it is well-nigh impossible for the inspector to determine, with any degree of accuracy, whether the proper interval has been observed. It would seem much more desirable to utilize a chart which records for a period of only 12 hours, with each signed and dated by the dairyman for presentation to the inspector when he next calls at the plant. This offers many advantages over the other type, but neither one is fool proof.

Milk Coolers

The necessity for proper handing of the milk after it leaves the pasteurizer is obvious. The piping and other equipment must be correctly designed and must be adequately cared for by the plant operator. It is well recognized that the covering of coolers is a desirable feature, unless they are placed in a small room where contamination by dust and flies can be excluded. These covers may be sliding glass doors, or removable tin sheets. In this way, the bacterial count of the milk should be kept at a minimum.

Bottling and Capping Equipment

Bottling and capping the milk is also a process from which contamination must be excluded. The bottling machines should be located so that the pasteurized milk will reach them by a short gravity route from the cooler. Where automatic capping equipment is too expensive for the small plant, a manually operated machine can be installed at a nominal cost. In this way, the person bottling and capping the milk does not need to touch the bottle caps.

Cleansing of Utensils

Cleansing of the dairy utensils in the plant is a very important item in the maintenance of a low bacterial count. Various methods are available for the satisfactory cleansing of bottles. Whether this is done by chemical means or by hot water and steam, the inspector should make sure that the washed container is thoroughly clean. He can test the efficiency by rinsing bottles, flushing containers, etc., with sterile water and making examinations of the washings.

Health of the Personnel

Routine examination of the personnel at dairy plants is important to prevent infection of the milk. Carriers of milk-borne infections are very dangerous around dairies. Routine examinations afford the best control. The health of the milk handler is the last step in the protective chain surrounding milk pasteurization plants. The objective of every plant should be well designed equipment properly operated by healthy workmen. With this combination it can be truly said: "Safe milk is pasteurized."

Editorials

SAFE MILK

THE Canadian Public Health Association stands unequivocally for the pasteurization of *all* milk supplies as the one and only means at our disposal for the final safeguarding of the health of the public from the dangers associated with the consumption of raw milk. This position has been stated and reaffirmed at the annual meetings of the Association from year to year. In so emphasizing the place of pasteurization in an adequate system of milk control, the Association does not overlook the fundamental importance of proper inspection of dairy farms and dairy plants, with all that this inspection entails. It is fully recognized that pasteurization can only render a milk safe from the danger of disease transmission. Pasteurization cannot make a dirty milk clean or guarantee that a milk is of proper quality. The importance of inspection of the raw milk and its source cannot be overstressed but, granted complete inspection, the public cannot be safeguarded unless the milk is properly pasteurized. The necessity for general pasteurization is amply demonstrated every year in our high death rates from diarrhoea and enteritis, in our milk-borne typhoid epidemics, our septic sore throat epidemics, the increasing cases of undulant fever, and our cripples from bovine tuberculosis.

There may be danger in the association of the terms "pasteurized milk" and "safe milk." Milk is properly pasteurized only when it is heated to a temperature of 145 degrees F., maintained at this temperature for thirty minutes, properly cooled and adequately safeguarded in filling, capping and final distribution. The procedure appears a simple one, but experience has shown that the conduct of pasteurization in dairy plants requires constant supervision and is dependent on continuous intelligent operation. The installation of pasteurizing equipment by dairy plants simply to meet the growing public demand for pasteurized milk and without the adequate instruction of those responsible for its operation and without regular and frequent inspection by the public health authorities, accomplishes little. Often the records of epidemics that have occurred among its users endanger public confidence in so-called "pasteurized" milk. In Canada it is the responsibility of every municipality to provide a safe municipal water supply. It is recognized that the operation of these plants calls for constant supervision by trained public health engineers. The story of a typhoid epidemic is too often the story of the careless operation of a

well equipped, well installed, but poorly supervised water treatment plant. If this be the situation in regard to water supplies, the urgency of the need for adequate milk supervision is evident.

Our objective must be safe, clean, wholesome milk. Under the present economic system, the small dairy farmer has little encouragement to strive for the production of milk of the best quality. In certain municipalities a premium is paid to the producer of high-grade milk. In the majority, however, all producers are rewarded alike, unless the milk be sour or very dirty. Dr. A. R. B. Richmond, in an article in this issue of the *Journal*, outlines the essential requirements for the production of clean and wholesome milk. But it is significant that, in his opinion, the first duty of the inspector must be that of an instructor to help the farmer improve his conditions. In the final analysis, clean milk on the farm is a question of the development of a sanitary conscience. No amount of regulations will succeed in changing the habits of the producer. Co-operation with him, demonstrations of better methods, and an understanding of the objectives will accomplish most in the production of wholesome milk.

The most important factor opposing a wider application of pasteurization is ignorance of the dangers involved through the use of raw milk. Where epidemics of milk-borne disease have occurred, a pasteurization by-law has quickly followed. After the sickness and deaths have passed into history and the new equipment has been installed, the wish is always expressed that it had been there before an epidemic had occurred. And the only excuse the authorities offer—a discouraging excuse—is: "We didn't know." But with evidence appearing every day in the daily press as well as in the medical journals, there is no reason for even the lay members of any board of health offering such a fatuous explanation.

The cost is often advanced against the installation of pasteurization. But let any municipality balance the cost of pasteurization against an epidemic such as occurred at Lee, Mass., in 1928, when 1,000 out of 4,000 population were ill at one time and 45 deaths occurred; or that at Kirkland Lake, Ontario, in December, 1930, when there were 500 cases of septic sore throat from the use of raw milk.

The point raised by Dr. J. W. McIntosh in the *Discussion* in regard to the necessity for a standard set of specifications for pasteurization equipment, is important. The specifications should clearly stipulate proper valves, automatic temperature recorders, absence of dead ends, etcetera, and should be such that the dairyman cannot be misled into purchasing or erecting equipment that will not be approved by the health authorities.

Proper pasteurization is the only means of assuring protection against milk-borne disease.

PUBLIC HEALTH NURSING

RUBY M. SIMPSON, Reg.N., and MRS. GEORGE HANNA.

Milk Clinics in Hamilton Schools

MILK has been used in Hamilton schools for malnourished and undernourished children for many years with much success. Its value is not due so much to the quantity of milk given, (although this is not unimportant,) as to the opportunity provided to discuss with parents the whole health problem of the child. Where marked physical defects are found, or where faulty health habits exist, these must be corrected before the taking of milk is of much value. Then, too, the question of food values and the best allotment of the family food budget can be considered.

In ordinary years children are weighed and measured early in the fall. Those underweight and any others showing signs of undernourishment or malnourishment are selected for a special physical examination by the School Medical Officer, who determines those suitable for the milk clinic. The parents are invited to be present. Physical defects, faulty health habits and food values are discussed, and if the parent promises cooperation, the child is put on a milk ration of half a pint at morning and afternoon recess. The clinics start in January and end at the Easter recess. Records show that 25 per cent to 30 per cent are restored to normal height and weight standards, while the great majority show classroom improvement in physical and mental fitness.

During the winter months of 1930-31, and again this winter, conditions of unemployment have greatly increased the demand on account of undernourishment. In March, 1931, over 800 out of a school enrolment of 22,000 were on the list, while $3,642 was spent from December 1930 to June 1931 for this purpose. This winter there were 866 enrolled during November, and this will no doubt be largely increased during the coming months.

Helen Wright, Reg.N.,
Hamilton, Ont.

Milk as a Food

MILK, nature's food for the young, is often regarded as the perfect food—containing as it does fat, protein, carbohydrate, mineral salts and vitamines. Studies, however, have shown that while it contains these essential elements it is not a complete food for adults or older children. Its chief value for individuals past the age of infancy is as an adjunct to a general diet.

Some very serious mistakes have been made because of the confidence of many people in milk as a perfect food. One occasionally sees mothers of children aged two, three or four years, who state, "My child isn't a very good eater but he takes plenty of milk, so I don't worry." This is a very serious mistake, as every child of this age requires a general diet including fruits, vegetables and cereals, as

well as milk. He should have not less than one pint of milk each day. This should include that which is taken on cereals, on puddings, in soups and sauces, as well as that which he drinks. Milk should be given him to drink at breakfast and at lunch or supper, not at dinner. It should be served with or after the dessert, never with the first course, for the reason that the small child who drinks a glass of milk at the beginning of the meal is often so satisfied that he refuses to finish his meal.

School age children and young adults require one pint of milk a day, as does the young child. Milk is an excellent source of protein which is needed for growth and repair of tissue. It is a source of vitamines which help in giving protection against certain diseases and it is a source of many mineral salts.

The expectant mother requires more than the usual pint of milk a day. Since new bones are being formed in her body, it is essential that she have a certain daily intake of calcium, the bone forming mineral. Milk and fruits and vegetables are the best sources of calcium, milk probably the best single source. The expectant mother requires at least four cups daily, about a pint and a half. She sometimes experiences a certain difficulty in drinking this amount and often needs help in planning meals so that either in cooking or with her food she may have it. It may be taken on cereals, in soups, in sauces, in or on puddings, junkets, etc., and in hot or cold drinks. The calcium which she takes into her body will, of course, be of very little use to her if she does not at the same time receive sufficient vitamin D. This she may get by exposing her skin to the summer sunshine, by taking cod liver oil, or a similar preparation.

Milk, then, is of value for individuals of all ages. It is particularly valuable for children and expectant mothers. A pint a day should be taken by children, nearly a quart a day by expectant mothers. It is an essential part of a balanced diet.

A. Thomson, Reg.N.
Department of Health, Toronto.

REPORTED CASES OF CERTAIN COMMUNICABLE DISEASES IN CANADA* BY PROVINCES—NOVEMBER, 1931.

Diseases	P.E.I.	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Diphtheria	1	28	13	291	328	94	23	4	28
Scarlet Fever	6	76	48	356	411	196	24	17	42
Measles	—	—	2	516	1080	109	134	2	77
Whooping Cough	5	21	—	165	596	33	34	10	92
German Measles	—	—	—	78	9	†	—	1	14
Mumps	—	156	—	88	426	151	87	2	32
Smallpox	—	—	—	—	13	2	36	3	2
Cerebrospinal Meningitis	—	2	—	3	5	4	2	—	—
Anterior Poliomyelitis	—	—	—	—	—	—	—	—	—
Typhoid Fever	2	2	5	236	101	20	5	2	3

*Data furnished by the Dominion Bureau of Statistics, Ottawa.
†Not reportable.

PUBLIC HEALTH EDUCATION

MARY POWER, B.A.

"Truly a Treasure House"

TO arrange an exhibit dealing with MILK—a subject of absorbing interest to the public—is a pleasure rather than an arduous task. There are certain fundamentals which must be kept in mind if an exhibit is to have the desired effect. In the first place, it must be attractive enough to draw the attention of the passer-by and, in addition, the material must be presented in such a way as to create a lasting impression.

The snowy white milk bottle, which occupied the central position, stood out in strong relief against a background of black velour. How natural and imposing this giant papier-mache model appeared! And, to the imaginative, how like a treasure house which, through its open doors, disclosed the fairy gifts within!

The purpose of the exhibit was to show in concrete form the many food products derived from milk and to emphasize the fact that they have a direct relationship to milk in its natural state. Although in different forms, they contain the constituents which give milk first place among foods—valuable protein, easily digested fat, high calcium content, and vitamines so essential to health and growth. The picture tells the story —"Truly a Treasure House" merely putting into words the opinion of the interested spectator who, as he looks at the crowded shelves and realizes that cheese, butter, ice cream, and concentrated milk have the one common source, appreciates their high food value.

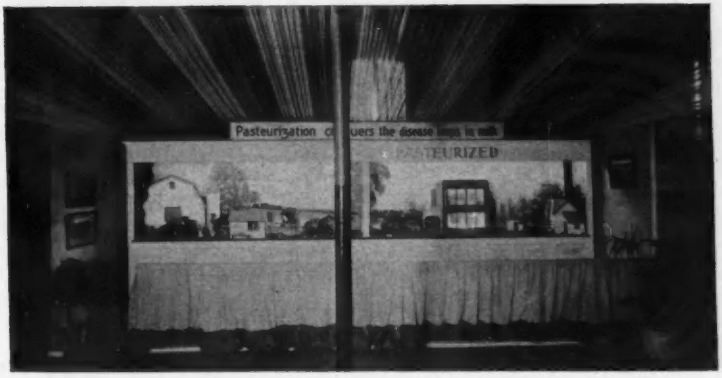
The Milk Utilization Service of the Dairy Branch, Department of Agriculture, Ottawa, has prepared a number of small exhibits which deal with the importance of milk from a health standpoint. These are available to public health workers upon request, and suggestions are gladly given to anyone who is planning an exhibit.

LAURA C. PEPPER,
Demonstrator and Lecturer.

"Pasteurization Conquers the Disease Imps in Milk"

AN attractive exhibit concerning milk and pasteurization was shown to many thousands of people in Toronto during Civic Health Week last spring, as well as in London at the Western Fair in September.

Twenty feet in length, three feet in width and ten feet in depth, the exhibit shows the milk in its journey from cow to consumer besieged by disease imps all the way to the pasteurization plant. The legend above the exhibit reads: "Pasteurization conquers the disease imps in milk." Underneath in large letters is the statement: "Safe milk is pasteurized."



"Pasteurization conquers the disease imps in milk."

This display was constructed of wood and beaver board and shows attractively coloured scenes of the farm, the milk-house, the delivery waggons, the pasteurization plant, and the consumer's house. Milk flows continuously through a large glass tube and are attractively lettered panels with suitable legends concerning the value of milk, the dangers of disease in milk, and the protection offered by pasteurization.

The exhibit, designed by Mr. Reginald F. Collins of Toronto, was presented to the Canadian Social Hygiene Council through the generosity of the Ontario Milk Producers' Association and is available to any representative organization wishing to use it as an educational medium.

C. P. FENWICK, M.D.

"Telling the Quality of Milk"

ILLUSTRATIVE of the quality of milk, the booth shown in the accompanying photograph was part of the exhibit of the Ontario Department of Health at the Canadian National Exhibition, Toronto, 1931, and proved very interesting to the public.

The third row shows: (1) Babcock test tube and samples of high and low butter-fat, (2) dirt discs, (3) a series of petri dishes showing, (*a*) milk kept at room temperature and (*b*) milk kept "clean, cool and covered" in an ice-box.

A section of the exhibit of the Ontario Department of Health, Canadian National Exhibition, 1931.

On the panel placed above the booth are figures showing the demand made upon the milk analyses service of the laboratories during the year. The top row of the booth represents contaminated milk, each bottle being credited with a specific organism of a milk-borne disease; the next row repeats the bottle arrangement exactly, but individual cards announce the fact that the organisms of the respective diseases have been killed by pasteurization.

The bottom shelf exhibits tubes showing the various constituents of a pint of milk and illustrates the food value of milk as compared with some of the commoner foods.

On the right will be seen a thermometer indicating the temperatures at which respective disease germs are killed. The boiling point is also registered, and the temperatures showing the range of pasteurization are shown in relation to the latter.

MARY POWER, B.A.

NEWS AND COMMENTS

P. A. T. Sneath, M.D., D.P.H.

Appointment of Dr. J. G. FitzGerald as Dean

ANNOUNCEMENT has just been made of the appointment of Dr. J. G. FitzGerald, LL.D., F.R.C.P., Director of the School of Hygiene and Connaught Laboratories, University of Toronto, as Dean of the Faculty of Medicine; and of the appointment of Dr. E. Stanley Ryerson as Assistant Dean. The appointment of Dr. FitzGerald follows the retirement of Dr. Alexander Primrose, who has served so acceptably in this office for the past twelve years. It will be possible for him to continue his other duties in the University through arrangements whereby the Assistant Deanship becomes a full time appointment. Dr. FitzGerald is internationally known in public health work, and brings to his new duties a wide experience in the field of medical education. His appointment is a significant indication of the important place that preventive medicine occupies to-day.

British Columbia

THE Province is being divided into statistical areas, the intention being that all census, epidemiological, statistical and other information published after January first will be based thereon.

Dr. H. E. Young, Provincial Health Officer, attended the fall meeting of the Dominion Council of Health which was held in Ottawa on December 15th, 16th and 17th.

Saskatchewan

THE Saskatchewan Relief Commission is aiding physicians and dentists in the drought area in order that it may be possible for members of these professions to continue to serve the communities. In the most severely affected districts, physicians are receiving grants of $75 or less per month. In these areas the Commission has increased the Government grant to hospitals, paying an additional fifty cents per patient per day. In the less affected areas the grant to physicians amounts to $40 or less a month, and the additional hospital grant is twenty-five cents per patient per day. To dentists the grants are, respectively, $25 and $15 per month, according to the need. These grants are made in view of the necessity that medical and dental services be carried on without interruption.

Manitoba

INVESTIGATION of all maternal deaths is being conducted by the Provincial Department of Health, (under the direction of Dr. F. W. Jackson, D.P.H.). In addition, Dr. McGuinness of Winnipeg is conducting a study of maternal deaths occurring in the hospitals of that city. This study includes the postmortem examination of all stillbirths.

Ontario

UNDER the auspices of the Canadian Social Hygiene Council, the motion picture "The End of the Road" has been exhibited in Toronto, attracting very large audiences. In addition to the feature film, supplementary short subjects and a brief address were presented. The plan followed was to screen the programme for audiences of men and women separately. It is estimated that more than 60,000 persons have seen the films during the fourteen days of their showing.

Excellent progress is being made by the Department of Health, City of Toronto, under the direction of Dr. G. P. Jackson, Medical Officer of Health, in the campaign to reach preschool children with diphtheria im-

munization. A series of clinics in various districts have been provided, to which mothers may bring preschool children for treatment. At the same time, the work of the two toxoid teams is being continued. In addition, physicians throughout the city report an increasing interest in the subject of diphtheria immunization, and large numbers of children are being immunized by family doctors. Through the combined efforts of the profession and of the Department of Health, it is hoped that the present low diphtheria rate may be reduced even further.

New Brunswick

DR. S. R. D. Hewitt, Superintendent of the Regina General Hospital, has accepted the appointment of Medical Superintendent of the St. John General Hospital. Dr. Hewitt assumed his new duties on January first.

DR. WILLIAM HAROP HATTIE

It is with a profound sense of great loss that we record the passing of Dr. W. H. Hattie, of Halifax, N.S., on December 4, 1931. Few men in the medical profession have contributed more to the progress of preventive medicine in their province and to the advancement of medical education than did Dr. Hattie.

Born in Pictou county in 1870, he was educated at Pictou Academy and graduated in medicine from McGill University in 1891. For several years he served on the staff of the Nova Scotia Hospital at Dartmouth, of which institution he was appointed superintendent in 1898. In 1913 he assumed the duties of Provincial Health Officer. Only the appeal of the service to be rendered was successful in drawing him from the field of psychiatry, in which he was so deeply interested. During the following years he gave outstanding leadership and laid well the foundations of a provincial health service. Again, in response to the appeal of a special service to be rendered in Dalhousie University, he resigned his provincial appointment in 1922 to become Professor of Hygiene and Psychiatry. In this position and as Assistant Dean of the Faculty of Medicine, he gave most valuable service to the University and to the Province.

Dr. Hattie was a prominent member of the Halifax Medical Society, the Medical Society of Nova Scotia, the Canadian Medical Association, the American Psychiatric Association, the Canadian and American Public Health Associations, and a Fellow of the Royal College of Physicians of Canada.

In his association with the Canadian Public Health Association as President in 1918, he not only gave inspiration but also clearly defined the position which the Association should occupy in Canada, and set in motion an organization which has now achieved, in some measure, the high purposes that he had cherished for it. It will not be alone for his achievements as a leader in preventive medicine, as a psychiatrist and as a great teacher of medicine that Dr. Hattie will be remembered; rather will he live in memory as a gentleman of the finest character. To Mrs. Hattie and to her daughter and her sons our Association tenders its deep sympathy.
